INFLUENCE OF CHANGING PATTERNS OF SUCROSE CONSUMPTION ON INDUSTRIAL USERS

Response by manufacturers of soft drinks, biscuits, cereals, cakes, confectionery, ice-cream, jams, canned products and other sugar-containing foods to the U.K. dietary guidelines that relate to sucrose consumption.

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This work is dedicated

to my mother and father

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ABSTRACT

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Key Words: Sugar, sweeteners, dietary guidelines, food manufacturers, sucrose consumption, food industry, sugar-containing foods, attitudes to sugar.

Sugar is intrinsically linked with the modern food system. Large sections of the U.K. food industry are dependent on its use and functional qualities. Supplies of sucrose entering the food chain have declined 25% between the 1950's and 1980's and currently stand around 37 kg/person/year. Furthermore, U.K. dietary guidelines over the past 14 years have consistently suggested caution over how much sugar is eaten, especially in manufactured foods. Dietary guidelines such as the NACNE report (1983) recommend average sugar consumption should be no more than 20 kg/person/year. Currently, two-thirds of sugar supplies are bought for use in food and drink manufacture. Continued pressures on sugar consumption and negative consumer attitudes to sugar may be reflected in lost sales of sugar-containing foods. The available information on U.K. sugar consumption is critically assessed. Although the main sources of sugar supply are identified, individual sugar consumption is shown to vary by considerable amounts. The place of sucrose is examined in relation to other sweeteners and why and where sugars and sweeteners are used in food systems. The promotion of "no added sugar" and "sugar free" products is examined since the publication of the NACNE report to the end of 1987. To further test the impact of changing patterns of sugar consumption on food and drink manufacturers a national survey of manufacturers who use sugar was carried out in early 1988. This was an attitudinal postal questionnaire and responses to the issue of sugar, diet and health were analysed. Respondents bought an estimated 650,000 tonnes of sugar in 1986, around 45% of the total industrial market. While the survey aggregate were fully supportive of sucrose, respondents reported that the majority of consumers were worried about sugar being bad for health and were actively cutting down on individual intakes. There were significant differences to the issue of sugar, diet and health dependent on company size, whether a company manufactured for a retailer's own label and if products had already been marketed at a "healthy eating" segment. However, in general, while manufacturers considered consumer attitudes to sugar to be important they had to be put in the context of other factors. So far the impact of changing patterns of sugar consumption is not reflected in the total average industrial purchases of sugar, although substantial "sugar-free" and "sugar-reduced" product niches have been established.

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PREFACE: AIM OF THIS THESIS

The United Kingdom, like many other Western countries, has seen the development of individual and national dietary goals and guidelines. These have mainly concentrated on modifying fat consumption, but a reduction in sugar intakes has also been an important feature of most dietary advice.

The British Government's Committee on Medical Aspects of Food Policy stated in 1984 that the present consumption of simple sugars should not be increased further, while Britain's "unofficial" quantative guidelines suggest a halving of present average sugar consumption levels (NACNE, 1983). Virtually all health education on diet that also mentions sugar, suggests a reduction or to "go easy" on eating it, in particular, when as an ingredient in manufactured food and drink products.

Today, less than one-third of sugar used in Britain is in the form of packet or table-top sugar, the rest is bought to be used as an ingredient in manufactured foods and drinks, especially in certain large food and drink categories such as soft drinks and confectionery. A possible hypothesis of the impact, and the degree of success of dietary change regarding sugar, is that any major change in sugar eating habits by the consumer may be reflected in the range of products using sugar as an ingredient. This has important implications for these food industries, the sugar processors as well as health-educators and policy-making.

The aim of this research is to explore to what degree there has been any important changes in sugar usage since the publication of the NACNE report in 1983. It also asks to what extent food and drink manufacturers believe dietary advice relating to sugar consumption is having an impact on their business. This is examined by considering sugar as a supplied ingredient rather than viewing it from any one type of manufacturer or product category, such as biscuits for example.

To assess the impact of dietary advice a national survey of food and drink manufacturers, who use sugar and other sweeteners as important ingredients, was carried out at the beginning of 1988. The results (detailed in Chapter Five) represent the opinions of food and drink manufacturers who bought more than 650,000 tonnes of sugar in 1986, the equivalent of 43% of the total industrial sugar market.

To place these results in context, this thesis also aims to consider the importance of sugar in the modern food system (Chapter One); dietary advice relating to sugar and health (Chapter Two); the available information on the U.K. sugar market, national and individual sugar consumption and recent pressures on sugar consumption (Chapter Three) and the use of sweeteners other than sucrose (Chapter Four). The important points of this analysis are discussed in relation to the original findings of the national survey of sugar and sweetener users and conclusions drawn on the state of sugar consumption in the U.K. today (Chapter Six).

CHAPTER ONE

AN INTRODUCTION TO SUGAR AND THE MODERN FOOD SYSTEM

1.1 What is sugar?

Sugar is one of the most commonly available foodstuffs in the world today. As well as being used in its granulated table-top form it is an ingredient in a large number and range of food and drink products. This thesis investigates and analyses the place of sugar in the U.K. food chain. It considers, in particular, dietary guidelines as they relate to sugar and the impact these have had on food and drink manufacturers that use sugar as an important ingredient. However, the word sugar is an ambiguous term. To put it into context, sugar has to be carefully defined and its role in human nutrition explained. It is then possible to establish the role of sugar in the diet.

Firstly, the subject of nutrition and sugar will be considered. Professor John Yudkin defines nutrition as:

> "... the study of the relationship between people and their food. It asks, and attempts to answer, questions relating to food production and processing, factors that determine food choice and ways in which this may be changed, the nutrient value of foods, the effects of excess or inadequacy of food or of particular nutrients and the role of diet in causing or preventing or curing disease. It thus requires a knowledge of some aspects of physiology, biochemistry, clinical medicine, psychology, sociology and epidemiology" (Yudkin, 1985)

This is a very broad based definition of nutrition and is useful to bear in mind when considering all aspects of sugar discussed in this thesis.

However, for answering "what is sugar?", a more workable definition is to consider the science of nutrition as:

> "... the study of nutrients and their digestion, absorption, transport, metabolism, interaction, storage and excretion" (Whitney and Hamilton, 1981)

Nutrients are those chemical elements and compounds that are required by the body and that must be supplied through the diet or from the environment. A

nutrient is, therefore, a substance obtained from food and used in the body to provide growth, maintenance and/or repair.

Food, for convenience, can be classified into ten categories:

1. Cereals, 2. Starchy roots, 3. Sugars and syrups, 4. Pulses, nuts and seeds, 5. Vegetables, 6. Fruits, 7. Meat, fish, eggs, novel proteins, 8. Milk and milk products, 9. Oils and fats, 10. Beverages.

The above foods supply the body with nutrients. There are six classes of nutrient:

1. carbohydrates
2. fats
3. proteins
4. minerals
5. vitamins
6. water

Good nutrition is, therefore, concerned with the overall balance of the food intake and not the consumption of any particular nutrient or group of nutrients. This must be borne in mind when any conclusions about diet are being reached. To examine sugars in more detail just one nutrient will be considered, namely carbohydrate.

1.2 Carbohydrate

The principal carbohydrate found in the blood of mammals is glucose. The health and functioning of every cell in the body is, to a greater or lesser extent, dependent on glucose - more commonly known as 'blood sugar'. Glucose is a molecule which is composed of 24 atoms, these are six carbon, twelve hydrogen and six oxygen atoms. The chemical formula is $C_6H_{12}O_6$.

All carbohydrates are composed of glucose and other Carbon-Hydrogen-Oxygen compounds. They come in three main sizes:

1. Single molecules (like glucose)
2. Pairs of molecules (two glucose molecules bonded together)
3. Chains of molecules (e.g. 300 glucose molecules strung together)

These three types of carbohydrates are known as monosaccharides, disaccharides and polysaccharides respectively. Therefore, a carbohydrate can now be defined as a compound of carbon, hydrogen and oxygen arranged as a monosaccharide or multiples of monosaccharides.

Carbohydrates are one of the most important energy sources in the human diet, although, historically, with growing affluence in industrialised countries, the consumption of carbohydrates has been falling and more animal products eaten. In fact, in many Western countries, fat usually contributes more energy to an individual's diet than carbohydrate.

There are two broad categories of carbohydrate that are important to the human diet. These categories are known as 'available' and 'unavailable' carbohydrates. 'Available carbohydrates' are starch and sugars useful to the body's tissues as a source of energy. 'Unavailable carbohydrates' are the structural carbohydrates of plants which are not digested by alimentary enzymes. The latter is also more commonly known as dietary fibre. In general, dietary fibre may be taken to mean the cellulose (cellulose is found abundantly in plants and is a polysaccharide composed of glucose and indigestable by humans), non-cellulosic polysaccharides and other polymers which make up most of the material of the plant cell wall (Royal College of Physicians, 1980) or, any substance of plant origin which is undigested by human alimentary enzymes (Trowell, 1972).

It is not the intention or within the scope of this thesis to discuss dietary fibre in great detail, but it is important to be aware of 'available' and

'unavailable' carbohydrates in any discussion of sugar, diet and health (see Chapter Two).

The main role of 'available' carbohydrate in the diet is to supply energy in the form of glucose. Starch is the most significant contributor of glucose in the human diet. Generally, all available carbohydrates are digested in the alimentary tract to release glucose which is then absorbed and utilised throughout the body. Starch is a polysaccharide and together with other polysaccharides is known as a complex carbohydrate. Simple carbohydrates are monosaccharides (glucose, fructose, galactose) and the disaccharides (sucrose, lactose and maltose), these are also known as sugars. To understand sugar, it is necessary to examine the simple carbohydrates. The five common sugars found in food are glucose, fructose, sucrose, lactose and maltose; these are briefly described below:

GLUCOSE: a monosaccharide which is quite sweet tasting, it is absorbed very rapidly into the blood stream and is found in its natural state in fruits and vegetables.

FRUCTOSE: a monosaccharide sometimes known as 'fruit sugar' since this is the sugar that gives sweetness to most fruits and also to many vegetables. Its chemical formulae is the same as glucose ($C_6H_{12}O_6$), but its structure is different. Fructose is the "sweetest" of the sugars.

SUCROSE: Sucrose is a combination of glucose and fructose which is hydrolysed in the digestive tract to release these constituents. Refined sucrose has become a major food ingredient and when sugar is discussed outside scientific circles, people invariably mean sucrose.

LACTOSE: this sugar is the main carbohydrate found in milk and is readily hydrolyzed into glucose and galactose.

MALTOSE: a disaccharide made up of two molecules of glucose. It is formed by the breakdown of starch during the early germination of seeds.

1.2.1 The importance of Sugars in the Diet

The description above gives a brief and general outline of the principal 'free' sugars in the diet. There are other simple sugars, but our main concern here is with those mentioned previously. Table 1.1 illustrates in more detail some of the other sugars available and their importance relative to the sugars already described:

TABLE 1.1

'FREE' SUGARS IN THE DIET

Main Classes	Types Present	Individual Species	Relative Importance in Diet (A)
Monosaccharide	Pentoses	Arabinose	Trace
		Xylose	Trace
	Hexoses	Glucose	Major
		Fructose	Major
		Galactose	Trace (B)
Disaccharide		Sucrose	Major
		Lactose	Minor (B)
		Maltose	Minor (B)
Oligo-Saccharide		Raffinose	Trace (B)
		Stachyose	Trace (B)
		Maltotriose and Higher Homologues	Trace/Minor (B)

(A) This refers to a typical UK diet
(B) The amounts of these carbohydrates are particularly dependent on the types of food making up the diet.

Source: Royal College of Physicians of London, 1980.

(NOTE: Oligosaccharides - these are sugars that lie between disaccharides and polysaccharides. They are found in small quantities in many vegetables, but they do not play a major role in the typical diet.)

A wide range of foods found in nature contain a variety of sugars and Table 1.2 gives some examples of the simple carbohydrates in a selection of foods. It is clear from Table 1.1. and 1.2 there is no one single 'sugar' in natural foods, but a variety of sugars which are, by definition, all carbohydrates. These sugars occur naturally in a wide range of foods, although only a few are major components of a typical diet in Britain. The major sugar in the diet is sucrose. This is not because people eat large quantities of sugar cane or sugar beet, but because they consume the sucrose extracted from these plants. This refined sucrose is bought as packet sugar and is used as an ingredient in many food products.

The current debate and cause for concern about sugar, concerns the intake of added refined sugar, which in the U.K. is mainly sucrose. For this reason and for convenience, sucrose will be referred to as 'sugar' throughout the rest of this thesis and only as sucrose when it is necessary to distinguish between different types of sugars.

1.3 Sucrose

The crucial difference between all sugars is their consumption in their "natural" state, (that is, as part of the foods they occur in) and in their "concentrated" form, (that is, as a processed product - extracted and concentrated from their plant source). Much of the sucrose consumed has been processed and is therefore in a concentrated form, although when used as an ingredient can somethimes form only a small part of the total product.

The commercial sources of sucrose are sugar cane (Saccharum officinarum) and sugar beet (Beta vulgaris). As Table 1.2 shows, cane contains between 10-20% sucrose and sugar beet 18-20% sucrose.

TABLE 1.2

CARBOHYDRATES IN SOME FOODS AND FOOD PRODUCTS

Product	Particulars		
	Total Sugar %	Mono and Disaccharides %	Polysaccharides %
Fruits			
Apple	14.5	Glucose 1.17; Fructose 6.04 Sucrose 3.78; Mannose trace	Starch 1.5 Cellulose 1.0
Grape	17.3	Glucose 5.35; Fructose 5.33 Sucrose 1.32; Mannose 2.19	Cellulose 0.6
Strawberry	8.4	Glucose 2.09; Fructose 2.40	Cellulose 1.3
Vegetables			
Carrot	9.7	Glucose 0.85; Fructose 0.85 Sucrose 4.25	Starch 7.8 Cellulose 1.0
Onion	8.7	Glucose 2.07; Fructose 1.09 Sucrose 0.87	Cellulose 0.71
Peanuts	18.7	Sucrose 4-12	Cellulose 2.4
Potato	17.1		Starch 14 Cellulose 0.5
Sweetcorn	22.1	Sucrose 12-17	Cellulose 0.7
Sweet Potato	26.3	Glucose 0.87; Sucrose 2-3	Starch 14.65
Turnip	6.6	Glucose 1.5; Fructose 1.18 Sucrose 0.42	Cellulose 0.7 Cellulose 0.9
Others			
Honey	82.3	Glucose 28-35; Fructose 34-41 Sucrose 1-5	
Maple Syrup	65.5	Sucrose 58.2-65.5 Hexoses 0.0-7.9	
Meat		Glucose 0.01	Glycogen 0.10
Milk	4.9	Lactose 4.9	
Sugar Beet	18-20	Sucrose 18-20	
Sugar Cane Juice	14-28	Glucose + fructose 4-8 Sucrose 10-20	

Source: deMan, 1980.

Sucrose differs in sweetness from other carbohydrates. Taking sucrose as a base of 100 (bearing in mind sweetness varies depending on, for example, the degree of dilution), some examples of relative sweetness are:

sucrose 100

fructose 170

glucose 50

lactose 30

(starch 0)

Source: Davidson et al., 1979.

1.3.1 Sucrose Refining

Sucrose as commonly consumed has undergone extensive refining. After refining, as Table 1.3 shows, the resulting sugar is almost 100% pure. This is true of both sugar beet and sugar cane when they are fully refined. However, it is possible to determine the source of the sucrose by the presence of very small amounts of non-sucrose constituents.

TABLE 1.3

COMPOSITION OF GRANULATED SUGAR

	Medium Granulated (%)	Fine Granulated (%)
Moisture	0.02	0.04
Total Solids	99.98	99.96
Sucrose	99.95	99.90
Invert Sugar	0.01	0.03
Ash	0.005	0.01

Source: Joslyn and Heid, 1964.

In refining, sugar cane and sugar beet undergo a complex industrial process. Historically the refining of sugar cane came first and this industry developed many methods that are now used, not only in the processing of sugar beet, but also in other food and chemical processes. These include multiple-effect evaporation, vacuum pans, crystallization, chemical clarification of both raw juices and refined liquors, bone char filtration and atmospheric drying as in granulators.

The first step in processing is the extraction of the raw sugars. With sugar cane this is done by crushing the canes between powerful sets of rollers, once they have been stripped of leaves and cut into suitable lengths. By this means most of the juices are extracted. The remainder of the sugar is obtained by soaking the residual canes in hot water. The juice that is extracted from the sugar cane in the primary crushing contains about 75% water, 20% sucrose, 4% organic matter and 1% mineral matter.

The crude juice is collected and freed from organic and nitrogenous matter by heating and treatment with lime; this starts a chemical reaction that allows the collodial organic matter to be absorbed. The clarified juice is concentrated by evaporation at reduced pressure and then allowed to crystallize. By means of centrifugal machines which mechanically separate the various components of sugar, about 90% raw brown muscovado sugar is obtained. The syrups or molasses separated out are further treated to obtain more sugar of a lower grade. The residue is fermented to produce rum.

The composition of raw cane sugar can vary a great deal, but on average it contains about 94% sucrose, 2.5% invert sugars (that is, the product of the hydrolysis of sucrose), 1% protein, 0.5% mineral salts and 2% moisture.

Raw beet sugar is extracted by diffusion. The sugar beet is cut into slices, mixed with water and the juices obtained clarified, evaporated in a vacuum pan and the raw sugar crystallized out from the resulting molasses.

The average composition of raw beet sugar is similar to that of raw cane sugar.

The raw beet and cane sugar now undergoes refining. Figure 1.1 gives a schematic representation of the technological process and the types of products produced from cane sugar and Figure 1.2 illustrates how a typical sugar beet factory operates. The end result of refining is mainly white granulated sugar or bulk liquid sugar for use in food manufacture.

It is the pure sucrose in its highly concentrated, fibre-depleted form that has become a cause for concern (see Chapter Two), since nutritionally;

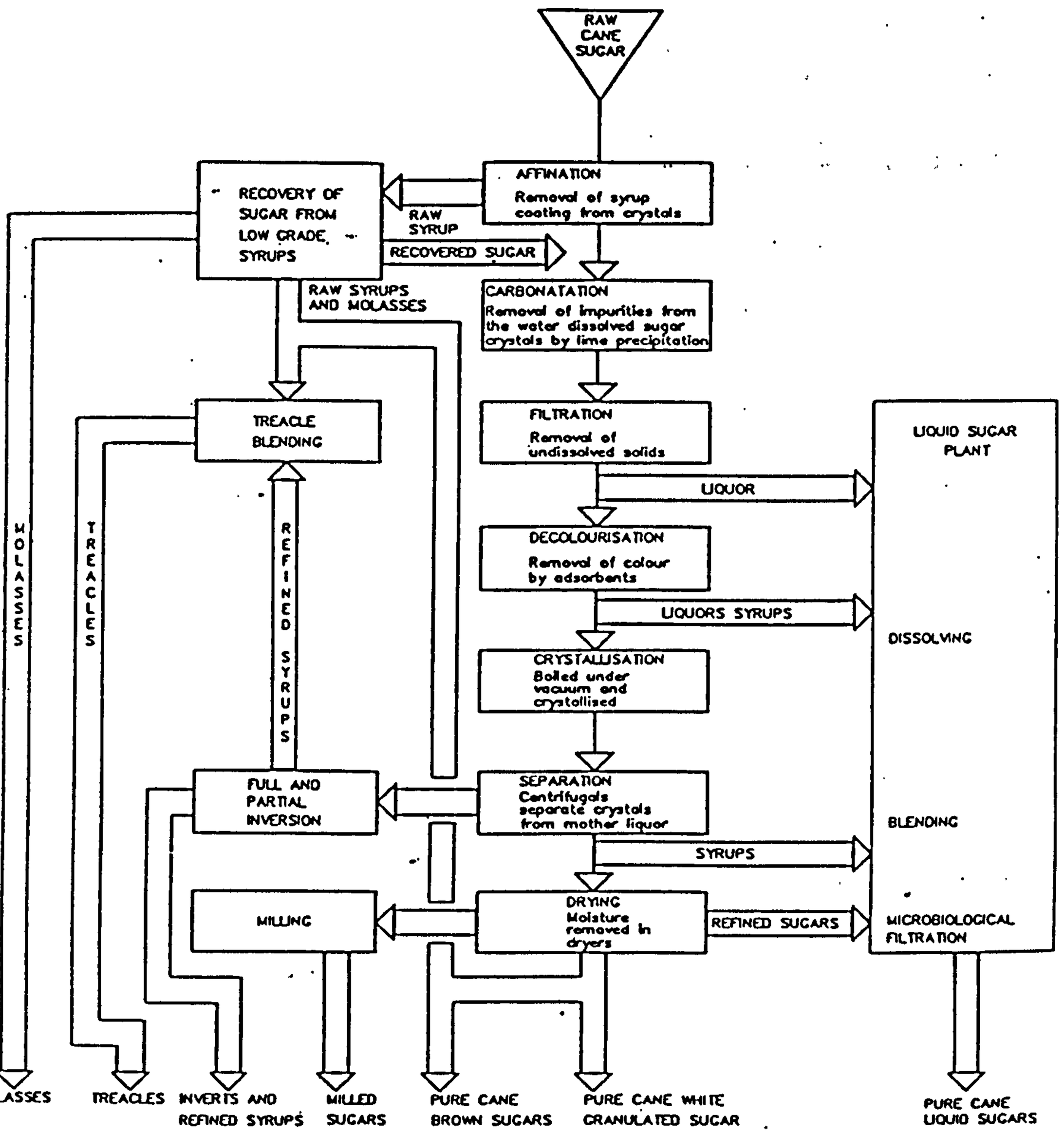
> "As a cheap and easily digested form of energy, sugar is a valuable food; but it lacks every nutrient save carbohydrate, its very attractiveness is a danger in that it tends to displace other more nutritious foods from the diet ... crystalline table sugar is one of the purest chemicals produced in large quantities by modern industry. It is practically 100% sucrose and contains no other nutrients, nor any potentially toxic compounds" (Passmore and Eastwood, 1986)

In this sense sugar - as refined sucrose - is not essential to the diet; it can be removed from the diet without causing any specific malfunctioning of the body although calorie intake is reduced. Of course, in practice, it would be very unusual to have a diet which is completely free of sugar. As has been illustrated earlier the typical diet contains a range of sugars, such as lactose and fructose, in a wide range of foods which are on the whole not processed or have sugar as an added ingredient. Complete removal of all sugars from the diet would mean many traditional foodstuffs would disappear and the energy deficit may need to be replaced. It would also effect large parts of the food industry.

The next sections propose a working definition of the modern food industry, examine the relatively recent appearance of large quantities of sucrose in the diet over the past 200 years and other factors that influence or relate to the ubiquitous commodity sugar.

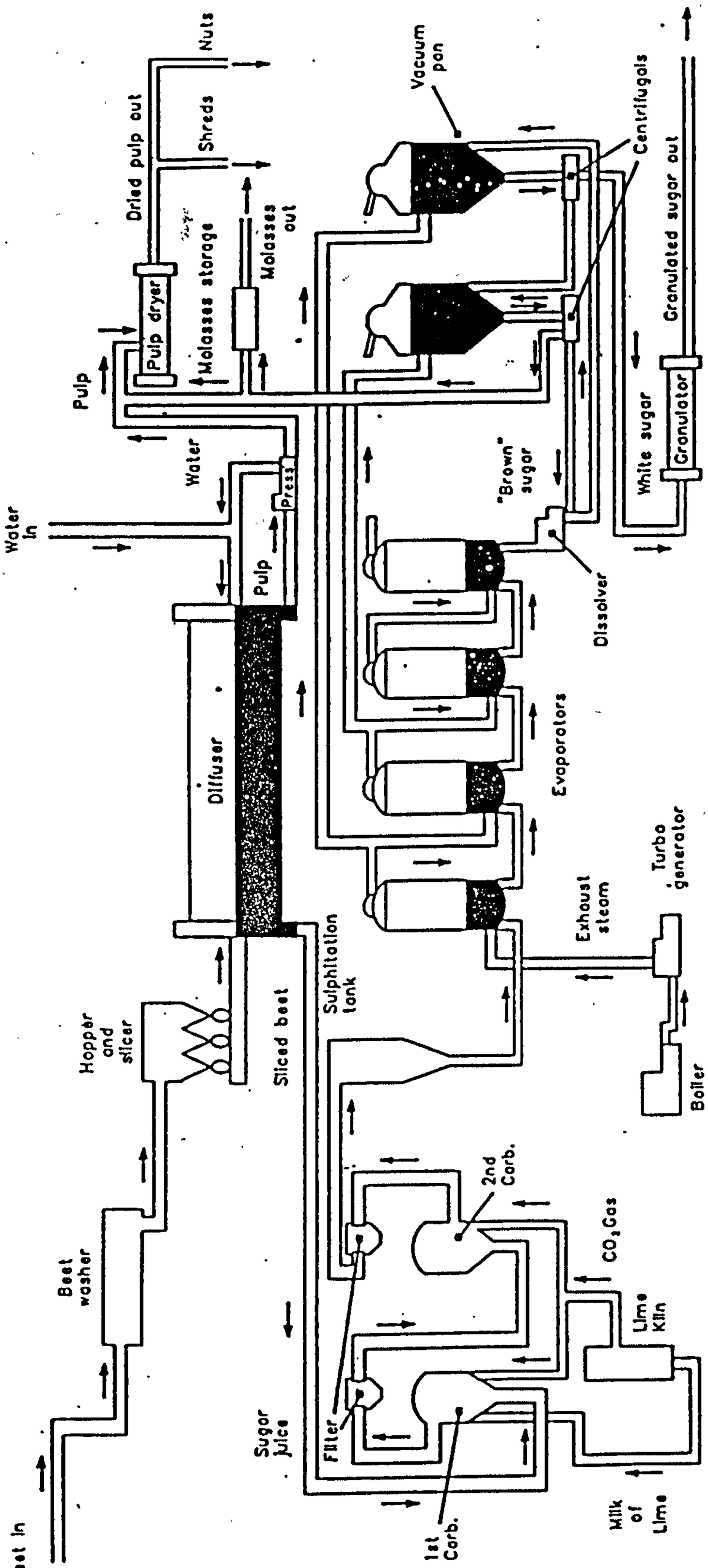
Figure 1.1

Sugar Cane Refining



Source: Monopolies and Mergers Commission, 1987

Figure 1.2



Source: Monopolies and Mergers Commission, 1987

1.4 The Modern Food System

1.4.1 Introduction

It has taken less than two centuries for sugar to become fully rooted in the food systems of the industrialised nations of the world. Originally being used through the sugar bowl, in its white granulated form and increasingly, with the industrialisation of food, as an ingredient in manufactured products. Today the use of sugar throughout the world is so widespread that it has become a generalised indicator of affluence, for example, during the period 1964 to 1975 it was observed in the Middle East, that for every 1% rise in the standard of living, sugar consumption increased 3% (Wursch and Daget, 1987). Generally speaking consumption has peaked in the rich Western world but continues to expand in the poorer developing countries (Harris, 1987). From the sugar industry's point of view this has posed a central, paradoxical problem for the world sugar economy, this is:

> "...the demand for sugar in the developed world has ceased to grow and in some cases is falling, while in the developing world there is a large unsatisfied demand because of the lack of resources to fill it. The consequence has been that the growth in the world's capacity in recent years has far outpaced the growth in consumption" (Harris, 1987)

However, the problem of sugar is more than simply one of "supply and demand", complex as this is. Sugar or more correctly the sensation of sweetness had and still has a profound cultural and social role in society with a sweet taste being preferred from early childhood (Desor et al., 1977). There are few individuals in the industrialised countries beyond the age of infancy who lack experience of sugar-containing foods.

In addition, the sharp rise in sugar consumption, from approximately 10 kg per person per year to 50 kg per person per year between 1850 and 1950 in the U.K., for example, has placed sugar eating as a major factor contributing to a change in the composition of the diet of people in developed countries.

As these countries have "entered into a new era of nutrition" (Hegsted, 1975), with the emphasis moving from essential nutrients in the diet to concern about the intake of fats and refined carbohydrates such as sugar, a curtailment in sugar eating has become a cornerstone in dietary recommendations aimed at preventing the prevalence of the so called "Western Diseases" (Trowell and Burkitt, 1981). In other words concern no longer hinges around minimum daily requirements to prevent dietary deficiency diseases, but about maximum levels as illustrated by dietary goals (Dubios, 1979).

1.4.2 Sugar and the industrialisation of food

Changes in the industrial food system and food manufacturing practice, together with the manifestation of a growing consensus relating diet as a contributing factor to diseases in industrialised countries, have served to accentuate the position of sugar in food and society from one as a "spice" and "medicine" (Mintz, 1985) to a much higher profile, often one portrayed as: "pure, white and deadly" (Yudkin, 1986).

The development of the modern food system helps to explain how sugar has become such a widespread and important dietary commodity. In this sense, that is, sugar as a commodity, it has to be seen in relation to changes that have taken place in the whole food economy. This takes into account the inter-relationships within the food sector itself and between more generalised changes in society, technology and the international economy. The problem is to integrate the various areas as they relate to food and in particular sugar to provide a cohesive framework for analysis.

1.4.3 The emergence of "agribusiness"

The evolution of the modern food system, with its roots in the early hunting and gathering societies, has emerged, ironically, with its reliance on a

narrower and narrower food base. The world's edible plant species have been calculated as approximately a quarter of a million and of these only some 1,500 have been incorporated into agriculture. In agricultural societies virtually the whole of human consumption was limited to thirty plants, with eight basic crops accounting for three-quarters of the human diet and only three crops - rice, wheat and maize - responsible for 75% of cereal intake (Sorj and Wilkinson, 1985). A characteristic of this reliance on a limited number of domesticated plant species has been to spread their cultivation to more and more growing areas around the world. Sugar is a good example of this process. Since sugar producing crops can be grown in both tropical and temperate climates, it is now one of the most widely produced agricultural commodities in the world. Between 1951 and 1970, for example, the number of sugar producing countries increased by 23 and practically all the countries that are suitable for sugar cane and sugar beet production are recognised growers (Grissa, 1976).

Until recently there has been a traditional theoretical difficulty in interpreting agriculture in a positive conceptual way with the rest of the food economy. However, with the emergence of a political economy of food and the concept of "agribusiness" in the middle of the 1970's, this problem was partly solved (Vergopoulos, 1985). Goldberg defines agribusiness as:

> "All of the interrelated private and public policy-making enterprises, from farm supply, farming and processing through distribution to the ultimate consumer - including all the private and public co-ordinating mechanisms that hold the commodity systems together and enable them to adjust to technological, political, social and economic change" (Goldberg, 1983)

Also, agribusiness, while being distinct, nevertheless has to be regarded as an industrial sector. In most cases the output of agriculture is not directly consumable but requires or is put through additional stages of industrial preparation. Food industries not only process agricultural products in order to

make them ready for consumption, but shape consumption standards downstream and primary production processes upstream. To this end agribusiness is dependent on a high level of mass consumption, homogenisation of food structures and the standardisation of the needs and resources available. Agro-industrial production implies the transition from dispersed and fluctuating output to concentrated, standardised output produced at a constant rate.

This has led to great leaps in productivity, for example, American farmers representing less than 4% of the U.S.A. labour force, produce the food needs of one fourth of the world's population (Chou, 1979). Although data such as this needs to be treated with caution since the decline in the farm labour force has to some extent been compensated for by growth in the labour requirements of other sectors of the food economy. The emergence of agribusiness is also characterised by a speeding up of developments in food systems. In food production the maturing of new technologies and techniques was, at first, over centuries, then decades and now it is possible for a new food substance to be distributed throughout the world in a matter of weeks!

The industrialisation of food has moved hand in hand with increasing urbanisation and the need for a reliable and safe food supply, met in the main by greater food processing. Table 1.4 gives some examples of the development of production and processing techniques:

TABLE 1.4

THE DEVELOPMENT OF FOOD PRODUCTION AND PROCESSING

Production	Processing
Domestication	Drying
Cultivation	Salting
Irrigation	Fermentation
Husbandry	Fabrication
Fertiliser	Chemicals
Breeding	Thermal processing
Fermentation	Refrigeration and Freezing
Chemical synthesis	Radiation
Genetic modification	Multipurpose packaging

These have all been used in modifying and developing food sources and the process continues; the newest techniques include:

- the novel constructions or processing of traditional foods, e.g. irradiation
- developing the use of non-traditional foods, e.g. yeasts
- products from chemical synthesis, e.g. fat substitutes
- genetic manipulation, e.g. carrots that can produce their own insecticide

Recent changes in food procesing have been translated into new food habits by consumers such as the increased use of convenience foods, fabricated foods from new ingredients like low-calorie products and the greater reliance on formulated meal replacements as a source of dietary intake. For the success of these processes agribusiness has to manipulate raw materials into the numerous products that constitute consumer choice. The ideal raw material has four basic qualities, it is;

1. as simple as possible
2. has standardised properties
3. its behaviour should be predictable in the manufacturing process
4. it must be versatile

Among the traditional raw materials sucrose meets these needs extremely well.

However, the success of world agribusiness has also given rise to a number of pressing problems. There is now a single problem of food supply in the world food economy characterised by the familiar food surpluses in the industrialised countries and food shortages in the developing world. There is the conflict between nations seeking autonomy in food as well as providing adequate income security for farmers. This to some extent is compounded by government and European Community subsidies, for example, which have become an important factor in the generation of surpluses.

Agribusiness has seen the emergence of new "standards" of food consumption and a profound change in diet linked to the re-orientation of the opportunities and techniques of food production, rather than food needs, in the areas of new products, new manufacturing procedures and new markets. There is increasing product differentiation and a continuing concentration among food companies. One of the results of this is that a small number of transnational companies control the majority of their respective markets and, therefore, influence consumption patterns. This oligopolistic control is exerted especially in food classes with the lowest nutritional value like chewing gum, sweets, biscuits, cereals, cake mixes, carbonated soft drinks and so on.

The implication of this is that:

> "... the development of a world wide agribusiness system is in the process of bringing about deep-seated and lasting changes in the conditions governing the production and consumption of food, on a global scale" (Leopold, 1985)

1.5 A Definition of "Food Manufacturing"

Agribusiness embraces the whole food economy - agriculture and its inputs, food processing, distribution and the concomitant supply industries, finally right up to the consumer. This thesis concentrates on possible changes in consumption that affect sucrose as it is processed and used in food and drink

manufacture. The food and beverage manufacturing industry is defined as in Table 1.5, in line with the International Standard Classification.

To provide further clarification of food processing as it relates to sucrose it is helpful also to distinguish between "first stage" and "second stage" processing. This distinction is important when interpreting what is meant by changing patterns of sugar consumption and the understanding of attitudes and behaviour towards sugar.

First stage processors seek reliable agricultural supplies and process them into standard products at minimum costs, maximising by-product uses and innovating to improve quality assurance and reduce the impact of supply fluctuations. First stage processors are the sugar factories and refineries producing pure refined sucrose part of which goes as packet or table-top sugar.

Second stage processors produce identifiable packaged goods, often highly differentiated, seeking real or apparent product innovations, using advertising and promotion to distributors and consumers to maintain and or develop demand and hence market shares. One of the key marketing activities is to encourage consumers to substitute convenience foods for unprocessed, replacing added value in the home with value added in the factory. It is cheaper, for example, and more convenient to buy raspberry jam manufactured by an industrial process than, at home, to pick the fruit, boil it with sucrose until it reaches the critical 'set' point, handle it into jars and seal them air tight and then store the produce hoping when you open the jar you are not met by green mould rather than your time-consuming labour of love raspberry jam!

The distinction between first and second stage processors becomes doubly important when studying policy implications. For sugar in the U.K. this becomes very evident when considering the policies of the Common Agricultural Policy (CAP) and in particular the European Community Sugar Regime. Under the CAP first stage processors are relatively favourably

TABLE 1.5

THE FOOD INDUSTRIES IN THE INTERNATIONAL STANDARD INDUSTRIAL CLASSIFICATION

31		Manufacturers of Food, Beverages and Tobacco
311		Food Manufacturing
312		
	3111	Slaughtering, preparing and preserving meat
	3112	Manufacture of dairy products
	3113	Canning and preserving of fruit and vegetables
	3114	Canning, preserving and processing of fish, crustacea and similar goods
	3115	Manufacture of vegetable and animal oils and fats
	3116	Grain mill products
	3117	Manufacture of bakery products
	3118	Sugar factories and refineries
	3119	Manufacture of cocoa chocolate and sugar confectionary
	3121	Manufacture of food products not elsewhere classified
	3122	Manufacture of prepared animal feeds
313		Beverage Industries
	3131	Distilling rectifying and blending spirits
	3132	Wine Industries
	3133	Malt liquors and malt
	3134	Soft drinks and carbonated water industries
314	3140	Tobacco manufacturer

Source: Statistical Papers of the United Nations. Series 19, No. 4, Rev. 2, 1968

treated. In the case of sugar from sugar beet (the first stage processors within the EC Sugar Regime) producers have guaranteed domestic markets as a result of intervention buying support and protection from Third Country supplies. Put very simply, for the first stage processors of sugar if their customers will not accept all their production they can always sell into intervention. Second stage processors or the food and drink manufacturers do not have this option, if the consumer does not accept or buy their products they could very likely go out of business. Chapter Three describes in more detail the position of the U.K.'s first stage sugar processors, Tate and Lyle plc and British Sugar plc.

1.6 The U.K. Food Manufacturing Industry

There are some 5,300 food manufacturing companies in the U.K. (Connor, 1983) which together employ nearly half a million people. In 1980 this equalled 2.3% of total employment in all industries and services and 7.6% of all manufacturing industries. Table 1.6 details the distribution of employment in food manufacturing between 1970 and 1980. Taking bread and flour confectionary, biscuits, sugar, cocoa, chocolate and sugar confectionary as examples of industries that use large quantities of sugar, these manufacturers employed 212,000 people in 1980 or nearly 42% of total employment in food manufacturing. As for the number of products types, an industry-funded trade association says:

> "There are more than 50,000 food and drink products available from food processors in Britain. Dozens of new products are tried out each week. The average family buys about 300 different food products a year" (Food and Drink Federation, undated)

Sales from these products give the U.K. food and drink industry a turnover of around £35 billion a year.

The concentration of companies in the food sector is much greater than the average of all manufacturing and the U.K. food industry is the most concentrated in Europe (Burns, 1983a). The share of sales held by the five

TABLE 1.6

DISTRIBUTION OF EMPLOYMENT IN U.K. FOOD MANUFACTURING ('000)

	1970	1980	% Change 1970-80
Grain milling	28	20	-28.6
Bread and flour confectionary	132	95	-28.0
Biscuits	47	38	-19.1
Bacon curing, meat and fish products	99	103	+ 4.0
Milk and milk products	58	54	- 6.9
Sugar	13	11	-15.4
Cocoa, chocolate and sugar confectionary	81	68	-16.0
Fruit and vegetable products	67	52	-22.4
Animal and poultry foods	28	24	-14.3
Vegetable and animal oils and fats	8	7	-12.5
Margarine and other food industries	41	34	-17.1
Total Food Manufacturing	602	506	-15.9

Source: Mordue, 1983

largest firms in different food category areas rose from 55% in 1958 to 71% in 1977 for food, while for all manufacturing the increase was from 55% to 65%. Industry concentration is particularly high in coffee, tea, chocolate drinks, instant beverage powders, soft drinks, wine, beer and spirits for drinks and also highly concentrated in processed packaged convenience foods such as canned soups, infant foods, frozen dinners, breakfast cereals, biscuits, chocolate confectionery, canned milk, instant potatoes and soups, ice cream and margarine. By contrast industries producing less processed or commodity type foods are more atomistic, for example, meat, fish, fruit and vegetables. A few undifferentiated foods are also highly concentrated such as sugar, oil refining and wet corn milling (glucose syrups). Table 1.7 lists some of the U.K. product categories and companies with more than 50% market shares.

TABLE 1.7

DOMINANT MANUFACTURERS OF PROCESSED FOODS IN THE U.K.

FOOD SECTOR	FIRM
Bread	Associated British Foods
	Rank Hovis McDougall
	Co-Op Wholesale Society
Packaged cakes	RHM
	Allied Lyons
Biscuits	United Biscuits
	Nabisco
	Rowntree
Margarine	Unilever
Ice Cream	Unilever
	Allied Lyons
Sugar	Tate and Lyle
	British Sugar
Chocolate confectionery	Mars
	Rowntree (Nestle)
	Cadbury
Soup	Heinz
	Unilever
Ready Meals	Heinz
	Unilever
Soft drinks	Schweppes
	Britvic Corona
Ready-to-Eat cereals	Kelloggs
	Weetabix
	Quaker Oats

Source: adapted from Cannon, 1988.

Total consumer food expenditure, at constant 1980 prices, has remained virtually static between 1978 and 1985 (with 1980 = 100, the low was 98 in 1978 and the high, 102, in 1985 - Central Statistical Office, 1988). Total consumer expenditure on food, at current prices, in 1986, was £32,342m or 13.8% of total consumer expenditure. In 1960 total food expenditure (at current prices) was £4,850m or 29.1% of total consumer expenditure and processed food accounted for 68% of total household food expenditure (Mordue, 1983). Today, if slaughtering is counted in the definition of processed food, only eggs, fresh fruit and vegetables are significant unprocessed items of consumer expenditure (Mordue, 1983). There has been a low, but positive income elasticity of demand for food, that is, as real incomes rise the volume of expenditure on food increases but at a lower rate than the volume of consumers' expenditure in total and therefore the proportion of total spending devoted to food has fallen.

In short, the U.K. food manufacturing industry is highly concentrated and has seen a considerable drop in employment (Table 1.6), but with increases in total expenditure for food, this suggests it has become increasingly capital intensive and automated to meet this demand. The principal battle in the food sector, in a market where the total rise in demand is very slight, is for bigger shares of the revenue that consumers do spend on food. This battle is partly expressed in large advertising budgets and in 1987 the food industry spent £325 million on advertising. This makes the food companies some of the country's top advertisers; in 1984, for example, Mars, Nestle, Cadbury-Schweppes and Rowntree were among the top ten advertisers in Britain and the total advertising spend on chocolate and sugar confectionery was more than £85 million in 1985 (Cannon, 1987).

1.7 The Modern Food System: Summary of Current Problems

Agribusiness in the U.K. shares a number of common problems with other parts of world agribusiness, the main difficulties agribusiness faces are:

1. Slow growth in demand for food products and continued changes in the pattern of that demand
2. Higher costs due to the production of more highly processed foods
3. The need for constant innovation in a competitive business environment
4. The need to incorporate new technologies, especially developments in biotechnology
5. Greater interest and pressures from producers and consumers in the political arena
6. Pressure from large-scale distributors where their market power has become formidable
7. Greater competition in the international markets concurrent with increasing protectionist tendencies on the part of governments
8. An increasingly conservative and tough regulatory environment

(Source: adapted from OECD, 1983).

1.8 "Sweetness and Taste": Some Cultural Considerations

When talking about sugar it is always important to remember "sweetness" is one of the primary tastes; the others being sourness, saltiness and bitterness. There are sweet taste receptors on the tongue and 'sweet' is tasted best on the tongue's tip (Logue, 1986). It would seem there is a preference among humans for sweet foods and drinks. Even after a satisfying meal the hedonic appeal of a late sweet course is not affected by satiety induced by earlier course, even sweet ones (Rolls, quoted in Mackay, 1985). However, although more than 1,000 different molecules are known to taste sweet with more being discovered and over a hundred of these compounds

being investigated for commercial development (Phillips, 1987) the structural basis for why compounds are sweet is only slowly emerging (Birch, 1987). Although humans may have a preference for sweetness, sweet foods are not universally well liked and consumed. There is great individual variation in the preference for sweetness (Meiselman, 1987) which is also determined by the foods in which the sugar is contained (Drewnowski, 1988).

However, one of the intrinsic uses of sugar is in food palatability and acceptability. For early homo sapiens this was perhaps the sweetness of ripe fruit, for example, thus making attractive a source of food that provides many vitamins and minerals necessary for body function and growth. Sugar is a concentrated source of energy and in a diet deficient of energy sugar would make an important contribution to energy intake (Mintz, 1985). However, as implied earlier, sugar has to be presented in the right condition to be perceived as acceptable and pleasurable. If pure sucrose is presented in a series of dilutions to a group of tasters it will be found that, while all dilutions may be perceived or recognised as sweet, only those dilutions in the region of 10% will be judged maximally pleasurable, with some variation for older people and children. This optimum concentration, termed the "bliss point", is well known and used by the modern day beverage industry (Mackay, 1985) with the judged optimum sugar content of a cola-type drink being 9-12%.

The most acceptable level of sweetness in liquids is attained with much less sweetener than in dry foods. A concentration of 40% sugar in dry food may appear only as sweet as a 10% sugar solution (Wursch and Daget, 1987). The perception of sweetness in a food is also affected by many other factors which determine the amount and type of sweetener that is used, such as the degree of carbonation of a soft drink. Some of the factors that affect sweetness, which also encompass the structural nature of the food, are its technology, the interaction with other tastes and the temperature when

consumed. These factors may affect the intensity, quality and duration of the perception of sweetness. These and the functional properties of sucrose account for the wide range of differing levels of sugar found in manufactured foods; Table 1.8 gives some examples of sweetener levels in selected food items to illustrate this point.

TABLE 1.8

SWEETENER LEVEL EXPRESSED AS % SUCROSE
IN SOME SELECTED FOOD ITEMS

Soft drinks - lemonade	9-14
Chocolate flavoured drink	8
Yogurt with fruit	12
Ice cream	14-18
Sherbet	27
Custard	6-13
Biscuits	25
Plain cake	25-36
Chocolate	50-60

Source: Wursch and Daget, 1987.

1.8.1 Other factors affecting sugar and sweetness in the modern food system

It is known, therefore, that people can perceive sweetness and this sensation is an integral part of some foods in nature and in many manufactured food and drink products (see Chapter Three for more detail on sugar consumption). In these cases a number of physiological and sensory factors determine the "perception" and "pleasure" derived from eating sugar and sugar containing foods. However, in addition to these factors, there are more elusive components surrounding sugar eating such as social, cultural and attitudinal factors that influence eating behaviour.

The amount of sugar in the diet and how much is consumed is caught up in one of the salient issues of modern consumer society, namely the question of "food safety", that is, concerns over diet being injurious to health, the safety of chemicals used in the food system and food borne disease and the

microbiological contamination of foodstuffs. Food safety has also become an emotional issue as well as a scientific and technological one with the food industry in particular being singled out for criticism. People feel that their food environment has become "unnatural" and the food industry is to a large part to blame:

> "As society has become more urbanised, most people have become more dependent on others to produce their food. This dependency has led to resentment and mistrust of the food industry, and a yearning for the good old days and ways ... it is not only the quality of food which disturbs this group, but the system and technological advances. They are disaffected, alienated and disappointed with an environment that is becoming increasingly man made, and yet, increasingly frustrating and incomprehensible" (Chou, 1979)

A longstanding "anti-sugar" trend has tied in very nicely with this, more recent, and general concern over food safety. The anti-sugar trend first developed in seventeenth century England among a group of physicians on grounds of health. Although from the first introduction of sugar to the late seventeenth or early eighteenth century there was no other apparent hint of reservation of any kind against sugar (Fischler, 1987). When it did emerge it took on a clear ethical-political dimension, for example, the creation in 1792 of the Anti-Saccharite Society which opposed slavery and boycotted sugar.

At the time that the anti-movement was getting more vociferous, sugar was becoming increasingly popular and consumed in greater quantities in England. From about 1680 the fashion for the hot, but bitter, drinks of coffee, tea and cocoa helped to secure a surge in sugar demand and the consequent rise in production which progressively raised the sugar trade to the point of importance it assumed in 1700 (Hobhouse, 1985). From this date on sugar consumption continued to grow until by 1900:

> "... sugar in the form of processed sucrose had become an essential ingredient in the British national diet" (Mintz, 1985)

It is not possible here to consider in more detail the history of sugar, but it is sufficient to say that at all points in the history of sugar, increased

availability and consumption have brought about changes in its social perception and usage. Today the attitude is one of ambivalence, but with a substantial risk of verging on the very negative. This image is illustrated by the "negative marketing" of sugar by the industry itself. Recent advertising and promotional material (Sugar Bureau, 1987) claims that one teaspoon of sugar is only 16 calories, or, in other words, "eating a little sugar is not so bad after all" (but for our sake keep eating it!). In contrast to this an advertisement from Tate and Lyle in 1976 had the headline "Sheer energy, from Mr. Cube" with copy that compares how many calories you get from sugar as opposed to other sources of energy and what good value this represented (Guardian, July 19, 1976).

Of more importance, the frontline of the anti-sugar trend has been increasingly strengthened by the growing body of expert and medical opinion that suggests, as part of the average modern diet, sugar is something to consume less of and is even injurious to health. This aspect of sugar eating is reviewed in Chapter Two.

Sugar as part of modern eating has also become to mean a certain life attitude that goes with greater wealth:

> "... affluence in lifestyle is frequently reflected as richness in diet and also in 'eating out'. Moreover, richness in diet is frequently associated with fat and sugar in the diet and 'eating out' with fast foods and snack foods. The latter also are not only identified with high fat and high sugar but reflect 'fast' as part of the life style and, in some respects, reinforce fast living" (Cantor and Cantor, 1977)

This attitude is probably reflected in the vast array of food and drink products that are sweetened to help their acceptance. However taste and lifestyle mean different things to different people and not least differences in perception between social classes. These all affect food buying habits and consequently the consumption of foodstuffs like sugar. Bourdieu, in his masterly work on all aspects of taste, neatly draws out and distinguishes how

social upbringing and life expectations influence taste in foods, for example, he writes:

> "Eating habits, especially when represented solely by the produce consumed, cannot of course be considered independently of the whole lifestyle. The most obvious reason for this is that the taste for particular dishes (of which the statistical shopping-basket gives only the vaguest idea) is associated, through preparation and cooking, with a whole conception of the domestic economy and of the division of labour between the sexes. A taste for elaborate casserole dishes [in France] which demand a big investment of time and interest, is linked to a traditional conception of woman's role. Thus there is a particularly strong opposition in this respect between the working classes and the dominated fractions of the dominant class, in which the women, whose labour has a high market value... tend to devote their spare time rather to child care and the transmission of cultural capital, and to contest the traditional division of domestic labour. The aim of saving time and labour in preparation combines with the search for light, low-calorie products, and points towards grilled meat and fish, raw vegetables (salades composees), frozen foods, yogurt and other milk products, all of which are diametrically opposed to popular dishes..." (Bourdieu, 1979)

To surmise, attitudes to sugar and sweetness are locked into the more general concerns about food safety in relation to food production and consumption and to eating behaviour associated with lifestyle and social class. However there is also one other consideration that affects the image of sugar which like these other issues can only be touched upon here. This final point is that sugar and sweetness has become closely associated with pleasure and by association sin. This is illustrated by everyday language where the word "sweet" and its derivations are associated with pleasant things such as love and money. More seriously a critique of anti-sugar literature has been termed as the "moral rhetoric against sugar" (Mechling and Mechling, 1983). This critique has been applied to analyse the anti-sugar literature of the 1970's, in particular books like "Sugar Blues" (Dufty, 1975). The "moral rhetoric against sugar" argues that the anti-sugar literature equates sugar eating with religious ideas of polluting the body with "dirt" and is a cause of "disorder" in an individual's life. This idea is finally transfigured to society as a whole, that is, sugar

consumption is implicitly responsible for the "dirty" things in society. These writers use this pseudo-religious language when discussing and presenting the scientific "facts" so that:

> "... the anti-sugar literature fills the role of public ritual, allowing the reader personally to move through... guilt, self-loathing, redemption and acceptance ... more pervasive than drugs and alcohol, sugar became pre-eminently the condensed symbol for pollution ritual, a powerful comment from the 1970's upon the 1960's (Mechling and Mechling, 1983)

In other words, abstention from sugar will allow an individual to be nutritionally born again!

1.9 Sugar and the Modern Food System: Conclusion

The growth of large sections of the twentieth century food industry has been dependent on the functional properties of sucrose (Lindley, 1988) and the U.K. food industry has been no exception. Agribusiness is the dominant concept in the world food economy and is a highly industrialised, extremely productive, technologically-based global manufacturing and service system. Views on the modern food system diverge between the good, the bad and the ugly, for example, on one hand:

> "Not only have the [American] farmers' productivity removed our concern for enough food, but also technological advances in food processing have concurrently provided us with unparalled varieties of food. Moreover, improved transportation and refrigeration have made it possible to eat seafood, fresh fruits and vegetables, once considered seasonal, throughout the year... better processes have made food safer, more attractive, more nutritious, and in many instances less expensive..." (Chou, 1979)

unparalleled

On the other hand, views that the modern food system is an example of the mechanization of the organic through chemical technique with the sole object to develop marketable taste sensations and palatable products that will sell well so that the food industry is no more than a:

> "... gigantic, highly integrated service system in which the object is not to nourish or even to feed, but to force an ever-increasing consumption of fabricated products" (Hall, 1974).

In the industrialised world, where the majority of sugar is no longer consumed as sugar but as products that contain sugar, the overriding public concern is food quality, as expressed in the examination of diet and health, chemicals used in the food system and the microbiological contamination of foodstuffs. Sugar and sweetness is an integral part of the foods found in nature and is now intricately linked to the smooth functioning of the modern food system. Sugar, together with other aspects of the Western diet, is now subject to continued and thorough expert and medical scrutiny resulting in strong recommendations to modify the whole Western diet and lifestyle.

Coupled to this is the peculiar and chequered history of sugar that has seen attitudes to sugar turn from being strongly positive to much less favourable. The growth in its acceptance and the corresponding advances in production to remake "the whole diet of a species" (Mintz, 1985) in such a short historical period is in many respects remarkable. It acts as a testimony to sugar's functional uniqueness, to the ingenuity of 'man' to change the immediate environment and his eating habits as well as exploit the species' innate desires. Undoubtably sugar is an emotive subject.

Also a great deal has been written about sugar. Tap in the key word "sugar" to the C.A.B. International database and more than 40,000 references are located, yet, as Yudkin points out:

> "There are dozens of books about the cultivation of the sugar cane and sugar beet, including books that describe the shameful story of ths slave trade between Europe, West Africa and the Caribbean. There are dozens of books giving the technical details of sugar refining and the manufacture of sugar containing food and drinks. But further accurate information about sugar as a food is not easy to come by..." (Yudkin, 1986)

Incidently, the first edition of Yudkin's book "Pure, White and Deadly" as published in America as "Sweet and Dangerous" in 1973 is quoted as an example of the anti-sugar literature in the mode of the moral rhetoric against sugar.

Some of the areas where knowledge on sugar is incomplete will become apparent in the following chapters of this thesis. Where there is no doubt is that any discussion of sugar by necessity involves a substantial ideological content. The belief systems we adhere to, the social class we belong to, even our early upbringing, our food habits and eating behaviour all influence the degree by which sugar is pleasure or sin in our perception of it.

No one, it seems, is immune from this "contamination" or can escape the cultural heritage wrapped around sugar, including the medical profession, as Fischler says:

> "... members of the medical profession have taken public stands which implied educational and behavioural advice. Such stands are indeed reminiscent of those taken frequently in the past, at least since the seventeenth century. The medical profession appears to have played an important role in the construction and evolution of social norms of behaviour. Although the history and sociology of science have as yet not thoroughly examined this role for matters to do with sweetness, one might hypothesise that medicine in this respect, has been influenced by ideological trends in society as much as it was influencing them" (Fischler, 1987)

This thesis investigates the fact and the fiction behind the consumption of sugar in modern day Britain. In particular it considers the influence of dietary advice, as regards sugar eating, on the U.K.'s largest "consumer" of sucrose, namely the food and drink manufacturers. In doing so it assesses to what extent the attitudes and the behaviour of the food industry has evolved and been constructed by advice from sections of the medical profession. First though, what expert advice has there been regarding sugar, diet and health, how much sugar is produced and is it known where and how much is consumed?

CHAPTER TWO

SUGAR, DIET AND HEALTH: AN ISSUE FOR CONCERN?

2.1 Introduction

People living in the U.K. have become increasingly aware that their diet is playing an important role not only in their general health, but also that the 'right' diet can contribute towards preventing a number of diseases. These diseases have been specifically described as "Western diseases", that is, those diseases which are characteristic of modern affluent Western technological communities (Trowell and Burkitt, 1981). The evidence suggests that several of these diseases have become more common in the Western world in the past 100 years (ibid), and so concern about diet and health is not simply confined to the U.K. (see later sections). A "Disease" is a disorder or want of health in mind or body, an ailment, cause of pain.

The concern here is with diseases that relate to diet rather than the whole spectrum of "Western diseases" which includes motor car accidents, industrial hazards and pollution, cigarette smoking and the consumption of alcohol and new drugs. As far as "Western diseases" and diet are concerned, Trowell and Burkitt (pioneers in developing the concept of Western diseases) have produced a list of such diet-related conditions (Table 2.1):

TABLE 2.1

PROVISIONAL LIST OF WESTERN DISEASES

METABOLIC AND CARDIOVASCULAR: essential hypertension, obesity, diabetes mellitus (type II), cholesterol gallstones, cerebrovascular disease, peripheral vascular disease, coronary heart disease, varicose veins, deep vein thrombosis and pulmonary embolism.

COLONIC: constipation, appendicitis, diverticular disease, haemorrhoids, cancer and polyp of large bowel.

OTHER DISEASES: dental caries, renal stone, hyperuricaemia and gout, thyrotoxicosis, pernicious anaemia, subacute combined degeneration, also other forms of cancer such as breast and lung.

DISEASES THAT MAY PROVE TO BE "WESTERN DISEASES": irritable bowel sydrome, ulcerative colitis, Crohn's disease, hiatus hernia, pelvic phleboliths and certain autoimmune diseases.

Source: Trowell and Burkitt, 1981

The magnitude of the prevalance of Western diseases, especially coronary heart disease which, for example, kills prematurely four out of ten men in the United Kingdom (James, 1988), has resulted in numerous measures by governments and health authorities in the developed world to draw up and implement national and individual dietary advice. Worldwide more than 50 expert committee reports have been produced which give a wide range of advice for good health practice including changes in dietary behaviour (Cannon, 1987).

In many instances part of the dietary advice has been a recommendation to reduce or at least not to increase the consumption of sugar (see later). In general, with minor differences between nations, dietary advice in the West centres on four major precepts:

1. Eat more dietary fibre (by eating a range of fresh foods and wholefoods)
2. Reduce total fat intakes (especially saturated fats)
3. Eat less salt, and
4. Reduce or do not increase added and refined sugar intakes.

Also considered important for good health is to take more exercise, to stop cigarette smoking and to drink alcohol only in moderation. This chapter reviews briefly the issue of sugar and health and the U.K. dietary advice as it relates to sugar eating and the recommendations which have been made.

2.2 Sugar, diet and health

It is beyond the scope of the aims of this thesis to analyse the whole question of sugar, diet and health due to the immense literature in this area. The following sections will simply point out the main areas where sugar has been implicated (see Table 2.2). However, among the scientific community, sugar consumption and the well-being of the individual is an area of considerable dispute and conflicting interpretation.

Take as an example diabetes. The debate as to whether or not excessive sugar consumption does increase the risk of diabetes has been going on for at least 100 years. Table 2.3, which gives a list of some of the major publications that argue for and against a role of excessive sucrose consumption in the aetiology of diabetes, aptly illustrates this point. There are still many unsolved questions relating to sugar intake and Western disease, particularly concerning excessive consumption and what is meant by the term "excessive". As a result, sugar consumption remains an issue of concern, at least for scientists around the world.

TABLE 2.2

DISEASES TO WHICH SUGAR CONSUMPTION HAS BEEN LINKED

AREA EFFECTED	EFFECT
1. Mouth, Teeth	Dental Caries
2. Stomach	Gastric and duodenal ulcers
3. Small Intestine	Absorption
4. Large Intestine	Diverticular disease, Haemorrhoids
5. Metabolism	Overweight Vitamin and mineral deficiency Diabetes mellitus Cardiac and circulatory system diseases
6. Psyche	Influence on and alteration of behaviour
General	
7. Acceleration	That is, fast longitudinal growth and earlier onset of sexual maturity as compared to preceding generations
8. Cancer	Particularly breast cancer

Source: Adapted from Schiweck (1985)

TABLE 2.3

MAJOR PUBLICATIONS THAT ARGUE FOR AND AGAINST A ROLE OF EXCESSIVE SUCROSE ON THE AETIOLOGY OF DIABETES

Yes or Probably Yes	No or Probably No
GREISINGER (1859)	BRIGHAM (1868)
CANTANI (late 19th century)	NAUNYN (1898)
MITRA (1903)	VON NOORDEN (1900)
HAVELOCK, CHARLES et.al. (1907)	SANDWITH (1907)
WILCOX (1908)	SAUNDBY (1908)
LE GOFF (1911)	BENEDICT (1909)
MORSE (1913)	LEMANN (1911)
HARRIS (1950)	ALLEN (1913)
DEL GRECO (1953)	JOSLIN (1917)
CLEAVE (1956)	EMERSON (1924)
COHEN (1961)	DUFF (1928)
CAMPBELL (1963)	MILLS (1930)
GELFAND (1963)	HIMSWORTH (1935-36)
ALPERT (1964)	WALKER (1966)
YUDKIN (1964)	ZIGGLER (1967)
TSUJI (1970)	BAIRD (1972)
SCHAEFER (1971)	STARE (1973)
EDINGTON (1972)	TRUSWELL (1973)
PFEIFFER (1973)	KEEN (1974)
WALES (1976)	BIERMAN (1975)
	MEDALIE (1975)
	WALKER (1977)

Source: Mann, 1985

2.2.1 "The Saccharine Disease"

In Chapter One, available carbohydrates were shown as being broken down into a simple sugar, glucose or "blood sugar" to be utilized by the body and provide energy. It was also briefly mentioned that there are 'unavailable' carbohydrates or, as they are known today, dietary fibre. One of the major shifts in nutritional thinking has been the new emphasis placed on eating foods complete with their dietary fibre rather than fibre-depleted foods (Trowell et al, 1985), or put another way, eating unrefined instead of refined carbohydrates.

Surgeon-General T.L. Cleave was one of the first people to argue that fibre-depleted foods were disruptive for health. He singled out white flour, but in particular he indicted sugar and sugar products (Cleave, 1974). This is because sugar, as generally consumed in the form of refined sucrose, is far removed from its natural state, (that is, sugar cane and sugar beet) and from sugars as eaten in sweet-tasting vegetables and fruit. In this respect sucrose in comparison to sugar cane and sugar beet is even more changed by processing than white flour is in comparison to wholemeal flour. Cleave said:

> "... as the body was evolved to the consumption of natural carbohydrates, no harmful over-consumption of these would occur, no matter how much of them might be needed to satisfy the calorific requirements; whereas the opposite was true of the refined carbohydrates, which were only too likely to be over-consumed -especially in the case of sugar..." (Cleave, 1974)

He argued that we are seeing the manifestation of a single master disease, a refined carbohydrate disease or, as he called it, the "saccharine disease", that is, related to sugar. Cleave's concept was based upon evolutionary, epidemiological and scientific research.

Haber et al (1977) provide a practical example which illustrates Cleave's point. They asked ten healthy volunteers to consume a standard meal of apples and the equivalent amount as apple juice, that is, as a fibre-depleted food, as quickly and comfortably as they could. The average time to finish the meals was 17.2 minutes for apples and 1.5 minutes for apple juice. When the solidity of the apples was partially removed by homogenizing them into a puree, the average consumption time for the test meal was 5.9 minutes. Fibre-depleted or concentrated sugars (in this case apple juice) are ingested very quickly compared to the full-fibre, unconcentrated equivalents. In other words, Cleave argues that there is more likely to be excessive consumption of concentrated, fibre-depleted sucrose in the diet and this has the inherent potential to cause nutritional problems and perhaps even be damaging to health. He gave a number of examples illustrating these diseases in his book "The Saccharine Disease". These ranged, in Cleave's view, from such diseases as diabetes, constipation, diverticular disease, obesity, to dental caries and peridontal disease - all Western diseases as defined earlier. Other workers, in recent years, have shifted the emphasis of Cleave's work, concentrating on the role of dietary fibre rather than sucrose in the diet, but his conceptual ideas still carry great potency.

2.2.2 Problems associated with sugar and disease in Britain

In 1986 the Sugar Bureau, funded by the British sugar industry to provide public information, published an information pack consisting of a series of reviews on sugar and health under the general heading "Putting Sugar in Perspective" (Sugar Bureau, undated). These concentrated on obesity, diet and behaviour, diabetes, coronary heart disease and dental caries as each relates to sugar consumption. Some of these are the most widespread diseases in the U.K. Apart from diet and behaviour, the extent of these diseases are well

documented; diet and its affect on behaviour being very difficult to quantify as well as 'diagnose'.

- The problem of overweight is a substantial one in Britain, with about 5%-30% (at different ages) of the adult population and some 5% of children affected (Royal College of Physicians of London, 1983). By their mid-twenties, 31% of men and 27% of women are substantially overweight, that is, more than 110 per cent above the acceptable weight, and incurring a health risk. An inappropriate increase in weight in both sexes is common in the early twenties (ibid).

- Around 2% of the population suffer from diabetes which has been increasing over the past 20 years, but the rate of increase now appears to be levelling off (British Diabetic Association, personal communication, 1988).

- Coronary heart disease is the major cause of death in middle-aged adults in Britain and the rates are among the highest in the world (World Health Organisation, 1985). There has been no substantial reduction in the CHD rate as experienced in other countries such as the U.S.A. and Finland.

- Dental caries affects around 95% of dentate adults in Britain and each year 30 million teeth are filled and five million extracted by 20,000 dentists at a cost of £400 million (Sheiham, 1983).

2.3 Expert Reports That Give Dietary Advice on Sugar Intakes

2.3.1 Dietary recommendations, goals and guidelines

When considering dietary advice a distinction needs to be made between two types of recommendation. In this respect official recommendations on national diets have been appearing in two separate forms, written on different facets of nutrition, in different styles. The first are recommended dietary allowances (RDA's) and the second are dietary goals and guidelines (Truswell, 1987a).

The Food and Nutrition Board of the U.S.A.'s National Research Council has defined Recommended Dietary Allowances as:

> "The levels of intake of essential nutrients considered, in the judgement of the Committee on Dietary Allowances of the Food and Nutrition Board on the basis of available scientific knowledge, to be adequate to meet the known nutritional needs of practically all healthy persons" (Committee on Dietary Allowances, 1980)

In particular this means the required amounts of vitamins and minerals to stay healthy. Contrasted to these recommendations are the more recent dietary goals and guidelines. The aim of these is not to see the public are provided with essential nutrients (although this may be a secondary aim), but to reduce the chances of the public developing chronic degenerative diseases - especially the "Western diseases". Dietary goals and guidelines are derived, not from minimum consumption levels, as in recommended dietary allowances, but usually from the present estimated national average consumption. As a result their recommendations are expressed as food groups or even in terms of eating behaviour ("eat more bread and fresh fruit").

Dietary goals and guidelines focus on the centre of the range of intakes, as one authority says:

> "There is a major distinction between the RDA and Dietary Goals. The RDA are determined from basic research on animals and metabolic studies in humans, which examine the particular micronutrients presently considered essential... Nutritionists have greater confidence in their conclusions concerning micronutrients than in their observations about macronutrients. The Dietary Goals, which primarily examine macronutrients, are derived from basic research on animals, metabolic studies, and clinical trials with humans and epidemiological investigations. In addition and unlike the RDA, the Dietary Goals depend on using food consumption patterns" (Select Committee on Nutrition and Human Needs, 1977)

Recommendations regarding sugar consumption, therefore, fall into the realm of dietary goals and guidelines. Truswell (1987a) has analysed the recommendations of 17 sets of dietary goals and guidelines from 13 different countries including two from the U.K. The most frequent recommendation is

to limit fat. For sugar, 14 of the 17 recommend a limitation. Of these 14, half recommend either "reduce only if overweight" (2) or "do not increase sugar intake"; the other half recommend a reduction in present sugar consumption (Table 2.4).

TABLE 2.4

RECOMMENDATIONS FROM 17 SETS OF DIETARY GUIDELINES REGARDING SUGAR CONSUMPTION

Limit sugar

	(sets)
No statement	3
Reduce only if overweight	2
Do not increase	5
Reduce	5
Halve	2
Total	17

Source: Truswell, 1987a

2.3.2 U.K. expert reports that comment on sugar intakes

In Britain, during the last 14 years, there have been eight reports published by authoritative bodies that recommend general dietary change including advice about sugar consumption.

It must be noted that the reports, mentioned below, considered many factors that relate to diet and health. Their comments on sugar are made in the context of their full recommendations on all dietary components as well as the primary data they are based on. This section concentrates on those comments pertinent to sugar intake.

A. **DHSS Report on Health and Social Subjects No. 7 'Diet and Coronary Heart Disease', London, HMSO 1974.**

In this report a panel from the Committee on Medical Aspects of Food Policy (COMA) were asked to advise on the significance of any relation between nutrition and cardiovascular and cerebrovascular disease and on any indication for future action.

The COMA Panel said that they believed a reduction in the incidence of obesity to be desirable and that a continued fall in the intake of sucrose would assist in achieving this aim (p.21). They therefore recommended that the consumption of sucrose as such or in foods and drinks should be reduced, if only to diminish the risk of obesity and its possible sequelae (p.23).

This report contained a 'Note of Reservation' by one of the Panel members, Professor John Yudkin, who said: "...the Report has exaggerated the possible risk of dietary fat in causing I.H.D. (Ischaemic Heart Disease), and has minimized the possible role of dietary sucrose" (p.35). Such notes are extremely unusual and committee consensus is the norm.

B. **Royal College of Physicians of London and British Cardiac Society, 'Prevention of Coronary Heart Disease', Journal of the Royal College of Physicians, 1976, 10 213-75.**

In the section headed 'Other Factors', this report had this to say about sugar:

> "1. On the basis of evidence derived from historical and epidemiological sources, from dietary histories in survivors of myocardial infarction, and from experiments in man and animals, it has been suggested that a high consumption of sugar (sucrose) is an important factor in the causation of myocardial infarction and in peripheral arterial disease.
>
> 2. While it is true that there is a positive correlation between the death rate from CHD and sugar consumption per head of population in many countries, it must be noted that sugar consumption is strongly correlated with saturated fat consumption in these countries and also with cigarette smoking. In addition, the incidence of CHD is fairly low in many countries

with a high sugar consumption, e.g. in the Caribbean, Venezuela and Mauritius.,

3. Sugar does not raise the plasma cholesterol level of man, although large amounts may do so in some experimental animals.* In many individuals a high sugar intake can certainly raise plasma triglyceride levels and a reduction in sugar intake can lower plasma triglyceride levels.

4. At present, there is no firm evidence linking intake of dietary sugar and CHD and most workers do not regard a high intake of sugar by itself as an important factor in the aetiology of CHD.

5. Sugar is, however, an important source of calories and thus may contribute to obesity. Obesity, in turn, is associated with an increased frequency of diabetes mellitus, hypertension and physical inactivity and with raised levels of plasma triglycerides." (pp.45-46).

C. **DHSS Prevention and Health, 'Eating for Health', London, HMSO, 1978.**

Sugar is mentioned on two counts, firstly, advice for children and, secondly, for adults. The report says:

> "... sweet foods may help a child to develop a 'sweet tooth' and perhaps eventually to lose his teeth due to dental caries; therefore the use of sugar and confectionery should be limited" (p.79).

For adults the report says:

> "people need to watch the amount of fats and sweet foods they eat. Many people will need to cut down their intake of: visible fats in the form of cream, butter, margarine, fat on meat and fried foods; invisible fats, in cakes, biscuits, puddings, pastry, ice cream; sugar in sweets, chocolate, puddings, soft drinks, tea, coffee and other beverages.
>
> The reduction in energy intake which results from eating less fat and less sugar can be made up by eating more bread and more fresh fruit and vegetables including potatoes..." (p.79).

*Note: This point is made because research evidence shows strong links between raised blood cholesterol and the incidence of deaths from coronary heart disease (see Wheelock, 1986).

D. DHSS Prevention and Health, 'Avoiding Heart Attacks', London, HMSO, 1981.

As the title suggests, the booklet is about the steps that can be taken to minimize the risks of coronary disease and a discussion about this issue. For sugar, it identifies the two most relevant points from previous literature:

> "Not one of the expert committees has specifically recommended cutting down on the amount of sugar in the diet as a direct way of preventing coronary heart disease. However, several agree on two relevant points. Firstly, there are other good reasons for avoiding excessive sugar in the diet, such as preventing weight problems and dental decay (especially important in childhood). Secondly, the calories lost by reducing the amount of fat in the diet should be obtained not from refined carbohydrates like sugar, but by increasing the amount of complex, unrefined carbohydrate foods eaten..." (p.44).

E. 'Obesity', Journal of the Royal College of Physicians of London, Vol. 17, (No. 1) January 1983.

Sugar is mentioned many times in the recommendations of this report and it is quite critical of sugar in the diet:

> "In Britain the consumption of sugar per head is higher than in most other countries and, apart from its affects on dental caries, sugar is an unnecessary source of energy in a community with such a widespread problem of overweight. A halving of the average sugar consumption per head of the population would increase the nutrient/energy* density of the diet. (This, together with the tendency for control mechanisms governing appetite to respond by increasing the consumption of other energy-containing foods, would ensure that mineral and vitamin requirements were more likely to be met.)" (p.51).

The report goes on to say:

> "There is evidence that children who are prone to weight gain have a lower energy expenditure than average. This means that they need to consume less energy but similar amounts of nutrients as other children and adults. To do this satisfactorily the intake of dietary fats and sugars should be reduced."

*Note: The nutrient/energy density of the diet, in simple terms, means choosing foods that bring with them a reasonable supply of nutrients in relation to their calories. Values of the nutrient/energy density can be calculated and then used for comparing the comparative nutritional values of items used as alternatives within a diet, for example, a slice of bread or a piece of cake, 100g of meat or 100g baked beans and so on, although in practice it is the nutrient/energy density of the whole diet that is important.

... and ...

> "There is a need for food, wherever possible to have labels which indicate the energy content. Information about the fat and sugar content is also desirable. Food manufacturers should be encouraged not only to produce special low-energy substitutes for normal food but to reduce the fat and sugar content of a wide range of manufactured foods. This applies particularly to meat products, confectionery and desserts. Government should recognize the need to see an adjustment in the nutrient consumption of the population and should avoid legislation which encourages the consumption of fats, sugars and alcohol."

... even ...

> "Slimming organizations can be of help to overweight children and adults. They should encourage the use of low fat and low sugar diets"

... as well as ...

> "Cookery instructions in schools need to emphasize the production of attractive and appetizing meals with a lower fat and sugar content"

... plus ...

> "Catering organizations responsible for the provision of meals in schools, works, canteens, hospitals and other organizations have a particular responsibility to ensure that a varied menu is provided, with a choice of dishes that contain less fat and sugar than those currently being served" (p.52).

As far as this report is concerned, its message is quite clear: reduce fat and sugar from as many parts of the diet as possible!

F. The Health Education Council, 'A discussion paper on proposals for nutritional guidelines for health education in Britain', National Advisory Committee on Nutrition Education, September, 1983

More commonly known as the NACNE Report, the impact this paper has had throughout the country makes it by far the most important report published. The NACNE report, directly based on several earlier reports (see Wheelock, 1986), and its quantitative dietary guidelines have formed the basis of the nutritional changes currently underway. For example retailers' "healthy

eating" marketing strategies, new food product development, local government initiatives, the upsurge in media attention towards diet and health issues, to the 'low', 'less' and 'high' labels that appear on foods in the supermarkets, all to a great extent owe their existence to NACNE and its interpretation (see Chapter Three for more detail).

The basis of the NACNE recommendations centre around four items, namely:

1. FAT, especially saturated fat
2. SALT
3. FIBRE
4. SUGAR

The report says the scientific consensus suggests that a more healthful diet would consist of less fat, less salt, less sugar and more fibre. This means the new average diet for the nation, in energy terms, would consist of:

Protein	11% (no change)
Fat	34% (a reduction)*
Carbohydrate	50% (an increase)
Alcohol	5% (a reduction)

It also recommends that people should stop smoking and take regular exercise. These measures are designed as preventative steps which individuals can take to combat many of the diseases and illnesses prevalent in industrial societies. The report sets out two programmes to achieve its dietary goals, one for the 1980's and another, long-term proposal, to be accomplished over 15 years.

For sugar, interpretation of the NACNE recommendation would amount to a major change in consumption. For the 1980's there should be a gradual

*Note: For the long term (by the end of this century), NACNE recommends total fat intakes should be on average 30% of total energy intake. In particular, saturated fatty acids should on average be 10% of energy intake.

reduction of total average intake by 10%, from around 38kg per head per year (104.12gms/head/day) to 34kg (93.15gms/head/day) and thus from 14% of total energy to about 12%. For the long-term, average sucrose intakes should be reduced to 20kg per head per year (54.79gms/head/day).

The report goes on to say that sugar intake between meals from confectionery and soft drinks in particular should be reduced so that this amounts, on average, to less than 28gms per day of such sugar. In the long-term, it says that for sucrose, taken in the form of snacks, as distinct from total sucrose in the diet, a lower value of 10kg per head per year (27gm/head/day) should be taken.

G. **DHSS Report on Health and Social Subjects No. 28, 'Diet and Cardiovascular Disease', London, HMSO, 1984.**

The stance taken is very much the same as the 1974 report "Diet and Coronary Heart Disease", except this time it had more impact. Looking specifically at heart disease this report also made recommendations referring to how changes in the diet might be encouraged. The COMA Panel had this to say about sugars:

> "The Panel recommends that intake of simple sugars (sucrose, glucose and fructose) should not be increased further.
>
> These sugars and foods containing them are appreciable sources of food energy and may contribute to obesity. Certain foods containing these sugars may also contribute saturated fatty acids (e.g. cakes, biscuits). The Panel notes that restriction of intake of these sugars has been recommended on other health grounds (e.g. dental caries)" (p.6).

H. **'Diet, Nutrition and Health', Report of the Board of Science and Education, British Medical Association, March 1986.**

This report places particular emphasis on sugar and dental caries saying:

"Dental caries affects of 95% of dentate adults in Britain. Each

> year over thirty million teeth are filled and five million extracted at a cost of over 400 million pounds. The dental health of the nation is improving, yet in 1978 12% of adults in the age group 35-44 were endentulous" (pp.40-41).

In the section 'Dietary Objectives For The Nation', among other objectives, for sugar the report says:

> "As a result of many analyses and trials, it is proposed that the average intake of sugar should fall to between 11kg and 18kg per head per year.
>
> The decline in the intake of sugar in Britain together with the increased use of fluoride has led to a clear reduction in the incidence of dental caries. Sugar intakes in the form of confectionery, soft drinks and snacks should be restricted as much as possible. A limit of 10kg per head per year in this form should be the goal. Sugar contained within meals seems to be less cariogenic, but with the need to alter dietary consumption in an attempt to avoid obesity, only a further 10kg sugar per head per year should be contained in foods. This gives a total sugar intake of 20kg, about half the present annual intake per person." (p.55).

2.3.3 Recent developments

As mentioned earlier, sugar and health remains a contentious area. In the United States of America the Food and Drug Administration has recently published a report evaluating the health aspects of sugars contained in carbohydrate sweeteners by their Sugars Task Force (Glinsmann et. al., 1986).

The Sugars Task Force assessed the safety of dietary sugars as they are consumed in the U.S. The report looked at the level of intakes and reviewed recent scientific literature addressing the potentially adverse health effects associated with sugars consumption.

The report says:

> "In reviewing the effects of the consumption of sugars on health, it is important to note that dietary sugars are normally a significant source of energy for the body and that sugars added to the food supply for sweetening or other technical purposes enter the same metabolic pathways as sugars that are intrinsic components of foods."

The health issues addressed in the review that the Task Force considered major are:

dental caries

glucose tolerance

diabetes mellitus

lipidemias

cardiovascular disease (hypertension and atherosclerotic coronary artery disease)

behaviour

Other issues discussed are obesity, malabsorption syndromes, food allergies, calciuria-induced renal disease, gallstones, nutrient deficiencies and carcinogenicity. However, the report has been criticised by some experts on the way it posed the questions, namely - does sugar have a unique role in diabetes, obesity and so on. (See report "The Independent", Wednesday, Oct 22, 1986, p7.) The Task Force concluded overall that, with respect to the general recognition of the safety of sugars contained in the food supply:

> "The average daily intake for added sugars as a percentage of the daily calorie intake for the total population (11%) approximates the amount (10%) recommended by the Select Committee on Nutrition and Human Needs in its second edition of Dietary Goals for the United States.
>
> Evidence exists that sugars as they are consumed in the average American diet contribute to the development of dental caries.
>
> Other than the contribution to dental caries, there is no conclusive evidence that demonstrates a hazard to the general public when sugars are consumed at the levels that are now current and in the manner now practiced."

2.3.4 The British Nutrition Foundation

In Britain, The British Nutrition Foundation's Task Force on Sugars and Syrups (British Nutrition Foundation, 1987) looked at why sugar is used as a food ingredient, eating habits, the use and range of alternative sweeteners to

sucrose as well as sugars and health. In his forward, Task Force Chairman, Sir Cyril Clarke, says:

> "Our aim has been to tell the truth, and I hope we have shown that the delights of the table can be harmlessly maintained by sticking to a few simple rules, and take us into old age still able to masticate and with our taste-buds intact, which is not the case with even the most expensive dentures." (p.2)

The report - published after some delay due to arguments among experts of the Task Force - (see Cannon, 1987, pages 134-148) - goes on to make a series of recommendations. These are aimed at the general public, the health professions and education, the food industry, government, communicators and for further research. The recommendations to the general public are twofold:

> "(1) For many individuals, current consumption habits need to be modified. Frequent consumption of sugars and other potentially cariogenic foods and drink (for example, more than five times a day including meals) should be avoided especially at the end of snacks and meals, or in isolation. Replacement with less cariogenic items on some occasions provides one approach to the problem, particularly for children.
>
> (2) If the energy taken in from food and drink is greater than energy expenditure, it will lead to an increase of body fat. Eating and drinking habits and the items chosen should be governed by an individual's personal needs and over-consumption should be avoided. Those who are already overweight should consider, among other actions, reducing sugar consumption." (p.38).

For the future, the news that sugars and their links with disease are to be specifically investigated by a government advisory committee can only be welcomed. The panel (which met for the first time in February 1987) is a sub-committee of the Committee on the Medical Aspects of Food (COMA). Its members are:

Prof JVGA Durnin (University of Glasgow)
Dr J Garrow (Northwick Park Hospital, London)
Prof DJ Naismith (King's College)
Miss A Black (Dunn Lab)
Prof T Silverstone (German Hospital, London)
Dr KW Heaton (Royal Infirmary, Bristol)

Prof AA Jackson (Southampton University)
Dr AJ Rugg-Gunn (Newcastle University)
Dr EA Newsholme (University of Oxford)
Dr JI Mann (University of Oxford)

and it is chaired by Prof Harry Keen (United Medical and Dental Schools, Guys and St Thomas's Hospitals).

2.4 Conclusion

Over the past century or so the composition of the average Western diet has changed in many important respects. The amount of energy from fats and sugar has increased and that from starch decreased; the intake of dietary fibre has also fallen. This is illustrated by the example of dietary changes in rural Wales between 1870 and 1977 (Table 2.5) and the contribution of energy intake by various dietary components:

TABLE 2.5

DIETARY CHANGE IN RURAL WALES,

CONTRIBUTION TO ENERGY INTAKE (%)

	1870	1977
protein	11	11
fat	25	42
(unsaturated fats as % of total fat)	19	9
sugar	4	17
starch	60	30
fibre (g/day)	65	21
cholesterol (g/day)	130	517

Source: British Medical Association, 1986

In many instances, these changes to the basic diet have been experienced throughout the industrialized world. But to what extent has such a change in diet alone caused "Western diseases" and does a better Western diet mean the prevention of, or protection from such diseases? The answer is not known for

certain and there is considerable controversy surrounding virtually all aspects of diet and disease and, perhaps with the exception of vitamin deficiency disorders, there is no agreement on what might be achieved (Silman and Marr, 1985). Some of the reasons for this controversy are that the role of diet in relation to other factors such as "lifestyle" is not fully understood, there are conflicting experimental results, differing interpretations of epidemiological data and even vested interests play a part. The role of sugar in modern nutrition has been no exception to this controversy with many scientists believing sugar has been wrongly singled out, for example:

> "Antagonism towards sugar, usually irrational, has persuaded many members of the public that sugar is 'unhealthy' and therefore undesirable. This is untrue. Sugar is an important ingredient of the diet and contributes harmless pleasure to eating..." (Jukes, 1986)

or:

> "... there are many voices reaching the public ear who make accusations against sugar as a food. This has resulted in a situation which hypotheses, data which are incomplete, data from animal studies of questionable application to man and data which are erroneous and simply 'opinion' are widely and repeatedly disseminated to the public as 'facts' applicable to man..." (Stare, 1975)

Even though the incidence of caries has fallen throughout Europe despite sugar consumption remaining static (Honkala and Heikki, 1987), the strongest 'case' against sugar is still dental caries. Sugar appears as the most important dietary item in caries aetiology and its presence around plaque-covered tooth surfaces is essential for more than very limited caries development (Rugg-Gunn and Edgar, 1984). The incidence of caries is affected by the frequency of sugar consumption and the more frequently sticky, sugary foods are eaten the higher the caries rate (Gustaffon, 1954). On the basis of epidemiological evidence to achieve a widespread improvement in dental health with, for example, more than 75% of teenagers caries free, sugar consumption would need to be no more than 15kg/person/year (Sheiham, 1983).

The expert conclusions on sugar, diet and health to some extent are determined by the approach, that is, does sugar do you any good?, or, is sugar harmful for you?

However, overall the conclusion to be drawn from a review of expert committees' advice and recommendations on various aspects of diet in the U.K. between 1974 and 1986 is that sugar intakes should in general be reduced. In fact there is a strong body of opinion in favour of eating less sugar. Sugar eating, therefore, is an issue for concern for the general public and an excess may even be injurious to health. Of particular note was the advice from most of the reports to be careful when eating foods with added sugar (especially if the sweet foods also contributed dietary fats), the foods mentioned included:

sugar confectionery (sweets)

chocolate confectionery

puddings/desserts

soft drinks and other beverages

cakes

biscuits

snacks

Thus, overall, of the eight reports, three suggest a halving of current national U.K. sugar consumption (Royal College of Physicians of London, 1983; NACNE, 1983; BMA, 1986). The others recommended either to eat less or to not increase present intakes.

CHAPTER THREE

SUGAR CONSUMPTION IN THE UNITED KINGDOM

3.1 Introduction

Meaningful data and information on sugar consumption has often been difficult to collect and evaluate for the United Kingdom. For example, there are many problems in collecting reliable data about sugar consumption at the individual level and because of this the issue is being continuously debated and remains controversial (Honkala and Heikki, 1987).

The purpose of this Chapter is to examine how much sugar is actually eaten in Britain and how important a part industrial consumption plays. This task is relevant for any discussion about public sugar policy. This is especially so in the light of such advice as the NACNE report which recommends that sugar consumption should be halved before the year 2000 (see Chapter Two). It is important, therefore, to monitor the following three areas (Rugg-Gunn et al., 1986a):

1. how much sugar is consumed in Britain
2. variations in consumption with geographic and social variables
3. sources of sugars in our diet

There are four major sources of information on sugar consumption which are:

1. Consumption Level Estimates
2. The National Food Survey
3. Dietary Surveys
4. Industry sources

All of these will be explained and examined in more detail in later sections.

There are two ways in which most people consume sugar. Firstly, directly from the packet or, secondly, as an ingredient added to manufactured food and drink. Sugar from the packet, known as the retail or table-top market, means sugar individuals put into coffee and tea, sprinkle on cereals, use in home cooking and so on. Sugar used in manufactured food products, known as the industrial market, means the sugar bought by food and drink manufacturers and used in making such products as confectionery, soft drinks and so on, plus a whole host of other food products that have sugar added to them, but not necessarily as a major ingredient. Although this research concentrates on the industrial use of sugar, retail consumption will also be considered to put the industrial use into context.

3.2 Historical Trends in Sugar Consumption

History has shown that per capita sugar consumption within a country usually increases with the growing development and affluence of that country, reaching a plateau of around 45 kilogrammes per person per year. Or, as 'The Economist' said:

> "As countries start to get rich, sugar consumption rises steeply, not peaking until their people are affluent enough to fuss about their health." (August 10, 1985)

The amount of sugar available for consumption has grown sharply this century. From 1900 to 1970 world production of white sugar increased approximately sixfold and since world population approximately doubled during these same seventy years this has meant available sugar per person per day world-wide rose from 21 grammes to 51 grammes (Mintz, 1985). By the early 1980's nearly 10% of all food calories in the world were in the form of sucrose. Table 3.1 shows world sugar production between 1800 and 1986:

TABLE 3.1

WORLD SUGAR PRODUCTION

	million tonnes
1800	0.25
1850	1.50
1880	3.80
1890	5.20
1900	11.00
1950	35
1970	70
1982	101
(1986	100)

Source: Yudkin, 1986

Recent decades have seen a slowdown in the rate of increase in total world sugar consumption. In the half decade from the end of the Second World War, until 1949/50, it grew by 6.5% a year. During the 1950's it rose at an annual rate of 5% and in the next decade it increased by 4% until the 1970's when growth in sugar consumption averaged 2.2% a year. The rate for the 1980's is estimated at 1.6% a year (Goodwin, 1985). In particular, the slowdown in the rate of increase in consumption has been most marked in the industrialized countries.

As might be expected there are wide discrepancies in per capita consumption between countries. Table 3.2 shows a comparison in sugar supplies available for consumption between a number of different countries over the past 100 years:

TABLE 3.2

SUGAR CONSUMPTION IN VARIOUS COUNTRIES BETWEEN 1880-1982

(KG PER PERSON PER YEAR)

	1880-4	1933	1981/82
Spain	2.31	12.70	27
Italy	3.45	7.71	28
France	10.25	24.95	37
Germany	6.80	23.13	36
Great Britain	30.84	48.08	41
U.S.A.	17.24	45.36	36*
Denmark	13.43	55.79	44
Russia	3.49	6.80	39
Austria	5.99	25.85	40

Source: Adapted from Deerr, 1950; Burnett, 1966; Eurostat, 1985.

(*NOTE: The consumption of refined sucrose in the United States of America is not a true reflection of total sweetener consumption since sucrose has been replaced in many foods by the use of High Fructose Corn Syrups. Total nutritive sweeteners available for consumption in 1985 stood at 57.8kg per person per year, including 30.6kg of sucrose - see Chapter Four.)

The growth in the economic "consumption" of sugar is due to many reasons, not least the expansion of sugar beet production. Other factors have been the continued improvements in technology, the application of modern industrial methods, advances in applied agricultural science and the expansion in the industrialization of food, so leading to wider availability of sugar and a greater variety of applications as a food ingredient. Also important has been the combining of sugar with other food items. Not only in association with tea, coffee and cocoa, but as a blender with flour, fats and dairy products.

3.2.1 Early consumption in Britain

The rise of sugar consumption in Britain has been recent and dramatic, peaking in 1958 when supplies available for consumption stood at 52.39

kilograms per person per year. According to Burnett, in the 150 years between 1810 and 1958 per capita sugar available for consumption in Britain more than doubled, re-doubled and then doubled again (Burnett, 1966). Or, using Deerr's figures, this growth in sugar consumption took place in just over 100 years from 1850 to 1958 (Deerr, 1950). Table 3.3 shows sugar available for consumption from the 1700's to just before the Second World War. Consumption did not increase dramatically until the last quarter of the nineteenth century and apart from the extremes of external conditions such as World War, has been relatively stable for 100 years.

TABLE 3.3

CONSUMPTION OF SUGAR IN THE UK 1700-1937

(KG PER PERSON PER YEAR)

Period	Consumption	Period	Consumption
1700-09	1.81	1845-49 (a)	10.25
1710-19	2.27	1850-59	13.65
1720-29	3.63	1860-69	17.55
1730-39	4.08	1870-74	22.32
1740-49	3.63	1875-70 (b)	24.13
1750-59	3.63	1880-89	30.80
1760-69	3.63	1890-99	35.79
1770-79	4.99	1900-09 (c)	38.42
1780-89	5.44	1910-14	41.19
1790-99	5.90	1915-19 (d)	31.80
1800-09	8.16	1920-24 (e)	31.39
1810-19	7.71	1924-29	39.83
1830-28	7.98	1930-37	44.50
1830-39	8.07		
1840-44	7.44		

(a) First year of progressive removal of duties, 1845.
(b) First year of no duty, 1875.
(c) First year of imposition of duty, 1901. Consumption in 1901, 42kg. the then maximum.
(d) The Great War, 1914-18.
(e) Period of excessive prices, 1920-24.

Source: Deerr, 1950

There has also been another important change in consumption patterns. Before the Second World War the majority of sugar consumed was in packet form. In 1936, in a survey carried out by Sir William Crawford and H. Broadley, published as "The People's Food", it was found that average sugar consumption was 472.61 grammes (16.7 oz) per person per week. To be added to this was sugar consumed indirectly in confectionary, cakes, biscuits, jam, syrup and other forms, which Crawford put at 336.77 grammes (11.9 oz) per person per week). This gives a total figure of 809.38 grammes (28.6 oz) or the equivalent of 42.09 kilogrammes per person per year. This study indicated the split between the retail and industrial use of sugar was about 60:40 in favour of the retail market. This position had more than reversed by 1988, with two-thirds of sugar going for industrial use as section 3.4 will show, but first the sucrose content of food needs to be considered.

3.3 Typical Sucrose Content of Some Foods

To understand sugar consumption, particularly its industrial use, it is necessary to be aware that the sugar content of food products varies considerably. Table 3.4 gives a break down of the sugar content of a range of common foods to illustrate this point. However, even within food categories sugar content can vary greatly. Table 3.5 shows, for example, that among bran cereals alone, total sugar content varies from 0.5 grammes to 22.0 grammes per 100 grammes. It is also important to explain what 'sugar' actually means when it appears on food packets as an ingredient. 'Total' sugar is the figure that includes all sugars, that is 'natural' and 'added' sugar. 'Natural' sugars are the sugars that are already present in a food whereas 'added' sugar, as the name implies, are the sugars put into a food, not always just sucrose. The labelling of food products as far as their sugar content is concerned can often be confusing. For example, a claim of 'no added sugar'

TABLE 3.4

SUGARS CONTENT OF SOME TYPICAL FOODS

(COMPOSITION g/100g)

	Sugars g/100g
Muesli	26.2
Rice Krispies (Kellogg's)	9.0
Sugar Puffs (Quaker)	56.5
Chocolate (full-coated)	43.4
Digestive Biscuit (plain)	16.4
(chocolate)	28.5
Ginger Nuts	35.8
Shortbread	17.2
Wafer biscuits, filled	44.7
Fairy Iced Cakes	54.0
Fruit Cake (rich)	46.7
(plain)	43.1

Source: Paul and Southgate, 1978

TABLE 3.5

SUGARS CONTENT OF SELECTED BRAN CEREALS

Cereal	Fibre g/100g	Sugar g/100g	
Kelloggs 'All Bran'	28.6	15 g	Total Sugars (figure from McCance & Widdowsons 'Composition of Foods')
Kellogg's Fruit 'n' Fibre	6.4	-	Not available
Weetabix 'Farmhouse Bran'	20.0	22.0	Total Sugars (figure from manufacturer)
'Weetabix'	12.7	6.0	Total Sugars (figure from manufacturer)
Nabisco 'Shredded Wheat'	12.0	1.0	Total Sugars (figure from manufacturer) (none added)
Quaker 'New Oat Krunchies'	9.6	15.9	Total Sugars (figure from manufacturer)
Quaker 'Instant Hot Bran'	15.0	0.5	Total Sugars (figure from manufacturer) (none added)
Sainsbury 'High Fibre Bran'	29.0	13.6	Added sugar (figure from nutritional label)

Note: 'Added Sugar' provides a figure lower than that to be expected for total sugars.

Source: Slattery, 1986

often means no sucrose, but the product may still contain another 'sugar', such as apple juice. This in turn may have been 'added', but because it is not sucrose the food manufacturer is still allowed to claim 'no added sugar' for the product.

The fact is, literally thousands of food products contain 'sugars' whether they be 'natural' or 'added'. However, of these, it is not known, in the majority of cases, how much sugar is in a processed food product since many manufacturers do not label sugar content. For this reason working out individual sugar consumption is made consistently difficult. For the purposes of this Chapter and the examination of sugar consumption, 'added' or refined sucrose is being discussed.

3.4 The U.K. Sugar Market

The U.K. sugar market is dominated by two companies who between them control around 95% of the sales volume. These are Tate and Lyle plc. and British Sugar plc., the latter, since 1982, being owned by S & W Berisford plc, after a prolonged take-over battle (see Monopolies and Mergers Commission, 1980-81). In the U.K. British Sugar is the sole processor of sugar beet and Tate and Lyle the sole refiner of sugar cane. Between them British Sugar and Tate and Lyle accounted for 17.2% of total European Community sugar supply in 1986.

Tate and Lyle is a multinational company whose activities comprise of agribusiness, bulk liquid storage, cane sugar production and refining, sweetener production, commodity trading, service businesses, automotive, industrial and construction products and a variety of other activities. In 1984-85 the company turned over £1,627m.

The principal activity of the Berisford group is as a world-wide network of merchanting, processing and distributing with a turnover of £7,292m in

1984-85 of which British Sugar contributed £638m. The food division of the group incorporates a diverse range of activities, the main one being commodity trading. Other food related interests are sugar and animal feed production and wines and spirits. Further businesses include timber, leather, chemicals, oil, financial services and property.

Before Britain's accession to the European Economic Community in 1973, two-thirds of the nation's sugar was supplied by imported cane sugar and the other third from home-grown sugar beet. Since then the situation has changed, with sugar supply now roughly split half and half between sugar cane and sugar beet.

Production in Britain is intrinsically linked to the EEC Sugar Regime (i.e. a system of production and price controls operating within the framework of Europe's Common Agricultural Policy - see Halisham, 1986), uniquely so because of Britain's historical links with cane producers. Nearly all sugar cane imports from African, Carribean and Pacific countries (ACP), which have access into Europe under the Sugar Protocol of the Lome Convention, are refined by Tate and Lyle in the U.K. The company operates two refineries. The main one, with an annual production of 960,000 tonnes, is situated at Silvertown on the Thames, and the other, Westburn at Greenock, has a capacity of 145,000 tonnes.

The whole of the U.K. sugar beet quotas under the EC Sugar Regime go to British Sugar which, in turn, negotiates beet supplies through the National Farmers Union. Altogether there are 11,500 growers who supply sugar beet to British Sugar. In 1983/84 British Sugar had 13 sugar beet factories, many of which have been modernized and up-dated. These are now some of the most efficient beet factories in Europe and production since 1978/79 has been consistently over one million tonnes (see Table 3.6, line E). Table 3.7 gives a sugar supply balance sheet for the U.K., this gives total sugar available for domestic consumption as 2,621,000 tonnes for 1986/87 or 46.17 kg/per

person/per year.

3.4.1 The final destination of refined sucrose in the U.K.

Table 3.8 gives a breakdown of the retail and industrial consumption of sucrose for the ten years between 1976/77 and 1986/87. The key characteristic of this is the continued shrinking of the retail market and the stable nature of industrial purchases and even the slight increase in the industrial market in recent years.

Tables 3.9 and 3.10 show the disposal of refined sucrose for food in 1965/66 and 1984/85. Although not directly comparable as some food categories differ, interesting detail can still be commented on. There has been a noticeable shift in sucrose usage with soft drinks taking an 18.7% share compared to 11.7% over the 20 year period and a near 6% drop in confectionery use. Baking, biscuits and cereals has remained almost the same while the most dramatic drop has been in jam, marmalade and jellies from 15.3% to 3.4%. Another notable drop has been in the amounts used in brewing and cider down from 8.3% to 4.1%. An increase, but one that is not directly comparable, has been in the amounts used in ice-cream and the newer categories of yogurt and frozen desserts, up from 2.7% to 8.5% of industrial use. The other apparent increase in use is in the category 'miscellaneous others'. Altogether the industrial market has grown by 359,000 tonnes of sucrose over the same period. Chapter Four looks in more detail at the industrial use of sugars and sweeteners and it will be shown that some of the apparent 'falls' in sucrose consumption are due to switching to other sweeteners rather than shrinking product category markets.

Looking at Table 3.10 it can be seen that the industrial use of sucrose is confined to a limited number of food and drink product areas, for example, the soft drinks, sugar and chocolate confectionery industries account for nearly

Table 3.6

Statistics relating to UK home grown sugar beet

		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Consumer expenditure at current prices £ million	(A)	146	260	247	253	269	293	322	350	357	371	355
Sugar beet output £ million at constant prices (1980 prices)	(B)	106	119	123	170	184	202	195	187	249	185	219
Agriculture land use thousands hectares	(C)	195	198	206	203	210	214	213	210	204	199	199
Estimated quantities of crops harvested Thousands Tonnes	(D)	4,588	4,864	6,325	6,382	7,081	7,659	7,380	7,395	10,005	7,493	N/A
Processed food: production: sugar: production from home grown sugar beet (as refined sugar) Thousand Tonnes	(E)	770	666	605	900	984	1,137	1,106	1,092	1,418	1,062	1,250

Source: British Abstracts: Statistics 1986

Table 3.7

UK balance sheet for sugar (1,000 tonnes wse)

	1981/82	1982/83	1983/84	1984/85	1985/86*	1986/87 *(est.
1. Opening Stock (1 Oct), total	337	295	336	232	209	259
a. of which: "free"	235	190	149	121	50	50
b. 'minimum'	102	105	107	111	109	107
c. 'blocked'	0	0	80	0	50	102
2. Production, new	1092	1418	1062	1314	1210	1323
a. production counting to marketing year (1c +2)	1092	1418	1142	1314	1260	1425
b. "C" sugar	0	274	0	170	116	281
c. production available for domestic use (2a - 2b)	1092	1144	1142	1144	1144	1144
3. Imports (Third Country)						
a. as such - ACP	1111	1100	1183	1151	1106	1165
b. in processed products	38	43	40	34	46	42
4. Imports (EC)						
a. as such	169	177	121	115	137	90
b. in processed products	75	90	92	90	121	130
5. Available for domestic consumption (1a + 2c + 3a + 3b + 4a + 4b)	2720	2744	2727	2766	2604	2621
6. Domestic consumption	2283	2308	2258	2268	2243	2285
7. Exports (EC)						
a. as such	14	9	14	16	39	30
b. in processed products	47	50	49	50	54	58
8. Exports (Third Country)						
a. as such	123	163	218	202	157	120
b. in processed products	60	63	63	71	63	70
9. Closing Stock (30 Sept), total	295	336	232	209	259	267
a. of which: "free"	190	149	121	50	50	55
b. 'minimum'	105	107	111	109	107	110
c. 'blocked'	0	80	0	50	102	102

Source: European Commission work sheets.

* Note: There is a break in series due to changes in the procedures for recording sugar quantities involved in trade in processed products.

Source: British Sugar 1987

TABLE 3.8

U.K. RETAIL AND INDUSTRIAL SUGAR PURCHASES 1976/77 TO 1986/87

Year	Retail Consumption		Industrial Consumption		Retail & Industrial Consumption	
	tonnes	kg/person/year	tonnes	kg/person/year	tonnes	kg/person/year
1976/77	990,485	17.7	1,479,552	26.5	2,470,037	44.2
1977/78	997,000	17.9	1,423,000	25.5	2,420,000	43.4
1978/79	972,000	17.4	1,365,000	24.5	2,337,000	41.9
1979/80	925,000	16.5	1,452,000	25.9	2,377,000	42.4
1980/81	978,000	17.46	1,206,000	21.53	2,184,000	38.99
1981/82	894,000	15.95	1,389,000	24.80	2,283,000	40.75
1982/83	868,000	15.50	1,440,000	25.71	2,308,000	41.21
1983/84	816,000	14.50	1,442,000	25,52	2,258,000	39.96
1984/85	780,000	13.78	1,491,000	26,34	2,271,000	40.12
1985/86*	750,000	13.25	1,508,000	26.64	2,258,000	39.89
1986/87**	705,000	12.45	1,585,000	28.00	2,290,000	40.45

* preliminary
** estimates

Source: Sugar Bureau, 1987

TABLE 3.9

DISPOSAL OF REFINED SUGAR FOR FOOD IN THE U.K. 1965/66

(ESTIMATED TONNES, WHITE SUGAR EQUIVALENTS)

	Tonnes	% Total Ind: Use
Chocolate and sugar confectionery	359,000	32.3
Cakes, biscuits and cereals	190,000	17.1
Jams, marmalades, jellies	170,000	15.3
Soft drinks	130,000	11.7
Beers, wines, cider	92,000	8.3
Syrup and treacle	53,000	4.8
Canned goods	44,000	4.0
Condensed milk	30,000	2.7
Ice cream	18,000	1.6
Pickles and sauces	14,000	1.2
Cake and bun mixtures	5,000	0.45
Canned puddings	5,000	0.45
Quick-frozen foods	1,000	0.09
Total	1,111,000	100.00
Retail use	1,537,000	
Total	2,648,000	

Source: Selby and Taggart, 1971

TABLE 3.10

DISPOSAL OF REFINED SUGAR FOR FOOD IN THE U.K. 1984/85

(ESTIMATED TONNES, WHITE SUGAR EQUIVALENT)

		% of total
Soft Drinks	275,000	18.7
Baking, biscuits, cereals	240,000	16.3
Chocolate, confectionery & couveture	220,000	15.0
Sugar confectionery	165,000	11.2
Ice-cream, yoghourt, frozen desserts	125,000	8.5
Brewing & Cider	60,000	4.1
Jam, jellies etc.	50,000	3.4
Pharmaceutical & Chemical	35,000	2.4
Canned fruit & vegetables	25,000	1.7
Miscellaneous others	275,000	18.7
Total	1,470,000	
Retail use	797,000	
Total	2,267,000	

Source: Tate & Lyle, 1986

half the industrial market for sucrose (44.9%) and if baking, biscuits and cereals are added 61.2% of the market is accounted for. However, although the industrial use of sugar is limited to a small number of food and drink categories, within these are represented literally thousands of different food products, all with varying ingredients and hence amounts of sugar. It is the industrial use of sugar in many products that is often referred to as "hidden sugar", but sugar in many of these foods is the traditional and important ingredient. The total U.K. sucrose market is worth around £900 million per annum.

The industrial sucrose market consists of bulk and bagged white granulated sugar, liquid sugar, sucrose mixes and some speciality sugars. The retail market consists of packed white granulated and speciality sugars. Table 3.11 gives an estimated breakdown of the market by sugar types.

There are approximately 1,750 to 2,500 customers for sugar in the industrial sector. Out of these 15 account for 47% of the market and 45 for more than two-thirds (Table 3.12).

As mentioned earlier, the total sucrose market is split roughly 50:50 between Tate and Lyle and British Sugar. For Tate and Lyle, four customers account for 68% of the company's sales in the retail sector and 12 customers for 42% of sales in the industrial sector. For British Sugar four customers account for 56% of sales in the retail sector and 12 customers for 49% of sales in the industrial sector. Altogether in the industrial sector 20 buying points control more than 50% of the market and in the retail sector 14 buying points control more than 87% of the market.

Although refined sugar is produced by Tate and Lyle and British Sugar, almost half of it reaches its end-users, industrial and retail, through sugar merchants. Merchants were involved in about 1,200,000 tonnes of sugar purchased in 1985. They operate in two ways, these are 'true merchanting' and

TABLE 3.11

ESTIMATED SHARE OF SUGAR TYPES IN TOTAL SUGAR SALES BY VALUE

	1985 %
White granulated	
Bulk	31
Bagged	10
Retail Packet	32
Sub-total, white granulated	73 (equal to 1.6 million tonnes white sugar)
Liquid sugar	13
Sucrose-based sugar mixes	1
Speciality sugars	13
	100

Source: Monopolies and Mergers Commission, 1987

TABLE 3.12

SIZE DISTRIBUTION OF INDUSTRIAL CUSTOMERS

No. of Customers	Annual Consumption	UK Market Share %
15	Over 20,000 tonnes	47
30	5-20,000 tonnes	20
215	350-5,000 tonnes	18
1,500-2,000	Under 350 tonnes	15

Source: Monopolies and Mergers Commission, 1981

'nominal merchanting'. True merchanting is where the merchants buy sugar on their own account and subsequently re-sell this sugar to end-users. Nominal merchanting is where British producers sell to end-users and the merchant is responsible for processing the orders, invoicing customers and collecting payments. Price negotiations are usually, but not always, between the refiner and the final customers. However, the merchant bears the credit risk and is paid a flat rate per tonne by the refiner. There are five main sugar merchants in mainland Britain, these are:

Napier Brown and Co. Ltd.

James Budgett and Son Ltd.

Edward Billington (Sugar) Ltd.

S. Pigott and Son Ltd.

John Thomas (Sugar Merchants) Ltd.

3.4.2 Recent changes in the U.K. sugar market

Entry into the EC has put a severe strain on Britain's sugar industry - especially for Tate and Lyle. Tate and Lyle's over-capacity problems were made worse with the loss of 350,000 tonnes of Australian cane sugar on entry and the company has since closed a number of refineries. The company's position has been further weakened by the pricing system of the EC Sugar Regime which gives British Sugar better margins on its beet processing than Tate and Lyle on its cane refining.

The result has been a gradual squeezing of cane refining margins and increasing competition from British Sugar - this is reflected in Tate and Lyle's loss of around 20% of their market share in ten years. The recent Monopolies and Mergers Commission (MMC) report noted this point saying:

> "On the basis of evidence available to us we consider the CAP (Common Agricultural Policy) regime fails to provide cane refiners with adequate conditions, in particular with an adequate margin to

allow effective competition with beet refining." (MMC, 1987, p.187).

The MMC went on to recommend that the British Government should:

"make every endeavour to ensure that the cane refining margin is increased and put on a basis that allows Tate and Lyle to compete effectively with sugar refined from beet." (p.203)

In fact the expansion of sugar beet has been quite dramatic since EEC entry in 1973. Table 3.6 lines C, D and E, (see earlier) show this rapid growth in beet production. Sugar beet crops have increased by almost 50% as has the production of refined sugar. The increased crop has been achieved on virtually the same land space indicating substantial increases in yields per hectare. The push to expand production was further stimulated in 1975 by the British Government's White Paper 'Food From Our Own Resources', as well as by the incentives offered by the EEC Sugar Regime.

The conflict of interests between sugar beet and sugar cane has heralded a long awaited re-structuring of the British sugar industry. This appeared to come to a head in early 1986 with the proposed take-over of S & W Berisford, who own British Sugar, by the Italian company Ferruzzi. Ferruzzi is an agro-business conglomerate which is also Italy's third largest private sector concern, turning over US$6.3 billion. The company already controls Eridania, which has 45% of the Italian sugar market, and Beghin-Say, which has 33% of the French market. Controlling British Sugar would have also given it 50% of the British market.

More importantly, this would have pushed up Ferruzzi's European market share from 18% to 22.5%. Mr Paul Gardini, who heads the Ferruzzi group, is reported to have said:

> "That does not mean I can control European policy. But it does mean I can have a stronger voice in Brussels in order to influence quotas... My profitability is tied to quotas - the more quotas, the more profits." (Financial Times, April 2, 1986)

It was the threat of Ferruzzi's take-over of British Sugar that led Tate and Lyle to bid for British Sugar as well. This bid - which would have given Tate and Lyle 95% of the British Market - and the Ferruzzi bid, were both referred to the Monopolies and Mergers Commission in 1986. In the MMC's largest report to date, published in February 1987, it concluded that neither bid was in the public interest and Trade and Industry Secretary, Mr Paul Channon, accepted the MMC's recommendation and blocked both offers. The future of the U.K. sugar refining industry now remains as uncertain and as unstable as ever.

However, it is interesting to note a couple of points from Ferruzzi's and Tate and Lyle's campaigns to win British Sugar. Both companies campaigned vigorously to state their respective cases. To this end Ferruzzi recruited Sir Richard Butler, past president of the National Farmers Union, in the role of chairman of Agricola U.K., Ferruzzi's British company, to help them in their battle for British Sugar.

Meanwhile, Tate and Lyle put forward a set of guarantees to win the support of beet growers. These are interesting to quote as they help to pin-point current issues for concern in sugar industry. The 10 point package that Tate and Lyle said it would have undertaken if it won British Sugar was to:

1. Fully respect the Inter-Professional Agreement between British Sugar and the NFU, and explore with the union how this can be improved:
2. Publish separate accounts for British Sugar.
3. Maintain the present commitment to substantial capital investment aimed at improving efficiency.
4. Retain the present regional structure of British Sugar and in particular retain the West Midlands processing plants.
5. Vigorously develop sales to food and non-food outlets.

6. Strive for an increase in the U.K.'s maximum sugar quota.

7. Pursue the possibility of a U.K. ethanol plant.

8. Plan to meet the U.K quota in full (Note: in some years British Sugar has been unable to fulfil its European-set quotas, for example, when bad weather affects crop yields).

9. Fully support the research effort aimed at increasing beet yields.

10. Fully support research into the nutritional and health aspects of sugar, including mounting a substantial advertising campaign for sugar and beet products.

The emphasis of both Ferruzzi's and Tate and Lyle's campaign was to see production was not only maintained but expanded. It would seem production is destined to continue outstripping consumption for the short-term at least and alternative uses of sugar still appear some way from fruition. The last point above - 10 - is particularly pertinent especially since Figure 3.1 and Table 3.7 (see earlier) clearly show a distinct gap between U.K. sugar supply and consumption (that is, disappearance into the food chain). If the current pressures on sugar consumption, on the grounds of health, were to have a significant impact, this gap (Fig. 3.1) will probably widen further and the strain on production felt with severe consequences for sugar beet growers.

Figure 3.1. illustrates that in recent years both production and consumption have fallen, but production is still in excess. This oversupply is compounded even more when added to the total EC surpluses. Another point to note is that, under the current EC Sugar Regime, continued over-production may mean increasing pressure on the security of third country imports, that is, the 1.3 million tonnes of ACP cane sugar which currently has preferential access to the Community. Until the balance between cane and beet, production and possibly shrinking consumption is resolved or put on a sounder footing the U.K. sugar industry looks set for more change.

Figure 3.1

SUGAR PRODUCTION AND CONSUMPTION IN THE UK

SUGAR IN 1000 TONNES OF WHITE SUGAR EQUIVALENT

3250
3000
2750
2500
2750
2000
1750
1500

Total Resources

Human Consumption

1974-5 1975-6 1976-77 1977-78 1978-79 1979-80 1980-81 1981-82 1982-83 1983-84

YEARS

SOURCE: Eurostats

3.4.3 Summary: The U.K. Sugar Market

There has been a marked move from retail sugar supplies to sugar going for industrial use. There has also been, over the past two decades, a great deal of change between the product categories where it is used. The sugar industry is extremely concentrated with two suppliers controlling 95% of the U.K. sucrose market. Forty-five customers account for two-thirds of the industrial use and 14 buying points for 89% of the retail market.

Sugar supply is production orientated which in turn is controlled by the quotas and price mechanisms of the EC Sugar Regime as part of the Common Agricultural Policy. Supply of sugar has consistently outstripped human consumption and the feature of the sucrose market has been the growth in sugar beet production and the decline of cane refining. The sucrose industry has experienced considerable upheaval and uncertainty, especially since joining the EEC in 1973; the future promises to remain challenging and interesting.

3.5 Present Day Sugar Consumption in Britain

Public information about present day consumption is derived from the National Food Survey, Consumption Level Estimates and published dietary surveys. These sources will each be examined in turn, followed by a discussion on how accurate a picture this data presents of individual sugar intakes.

3.5.1 The National Food Survey

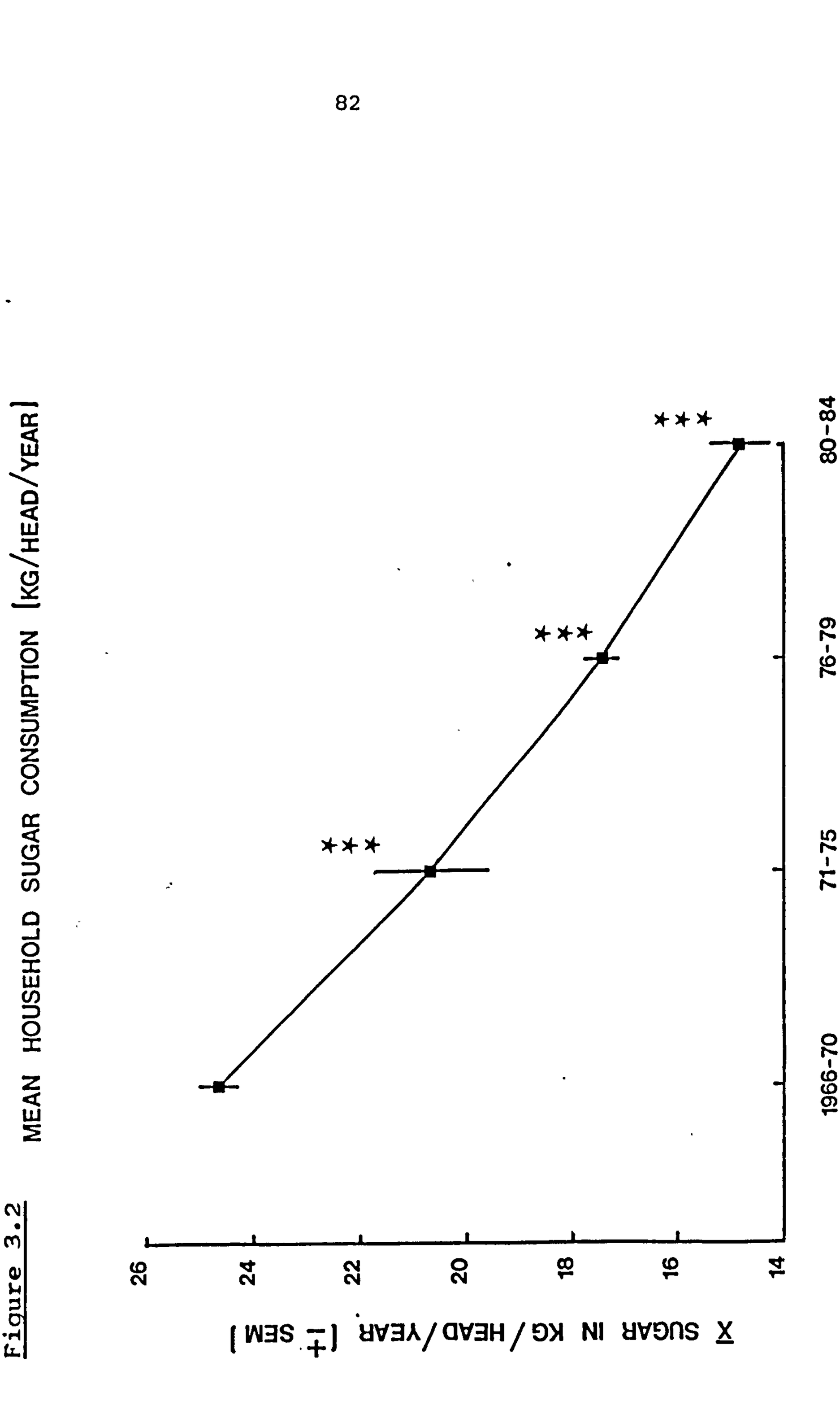
Data from the National Food Survey (NFS) is derived from a random sample of private households throughout the U.K. (6,925 respondents in 1986). Each household takes part for seven days with the 'housewife', that is, person mainly responsible for domestic duties, keeping a record of all food intended for human consumption entering the home during the period.

The key to understanding the NFS is that it is average household consumption and as such provides a representative and accurate picture. However, as far as sugar consumption is concerned there are a number of weaknesses in that it excludes certain sugar-containing foods eaten in the home and foods eaten outside the home, such as snacks, alcoholic drinks, sweets and chocolate confectionery and most soft drinks - all food categories with a large sugar input.

On the other hand the NFS provides a good picture of the purchase of packet sugar. According to NFS data, mean household sugar consumption has fallen sharply and significantly (see Figure 3.2) over the past two decades, from 24.96 kilograms per person per year in 1966 to 13.52 kilograms in 1984. The large variance for the period 1971-1975 is due to the sugar shortage of 1974 when consumption dropped sharply and then recovered, albeit not to the previous levels. Figure 3.2 makes it clear that there has been a continuous decline in the purchase of packet sugar for 20 years. In 1985, household packet sugar consumption was 12.40 kg/person/per year, and in 1986, 11.85 kg/person/per year, suggesting this decline is continuing.

Figure 3.3 represents NFS data in terms of household sugar consumption per person per week. This shows that consumption has fallen by 54% from 0.48 kilograms to 0.26 kilograms between 1966 and 1984 or from half a packet of sugar to nearly a quarter. Figure 3.4 shows that there is no great seasonal use of packet sugar and that demand is fairly constant throughout the year, suggesting sugar is a regular household item.

Figure 3.2 MEAN HOUSEHOLD SUGAR CONSUMPTION [KG/HEAD/YEAR]

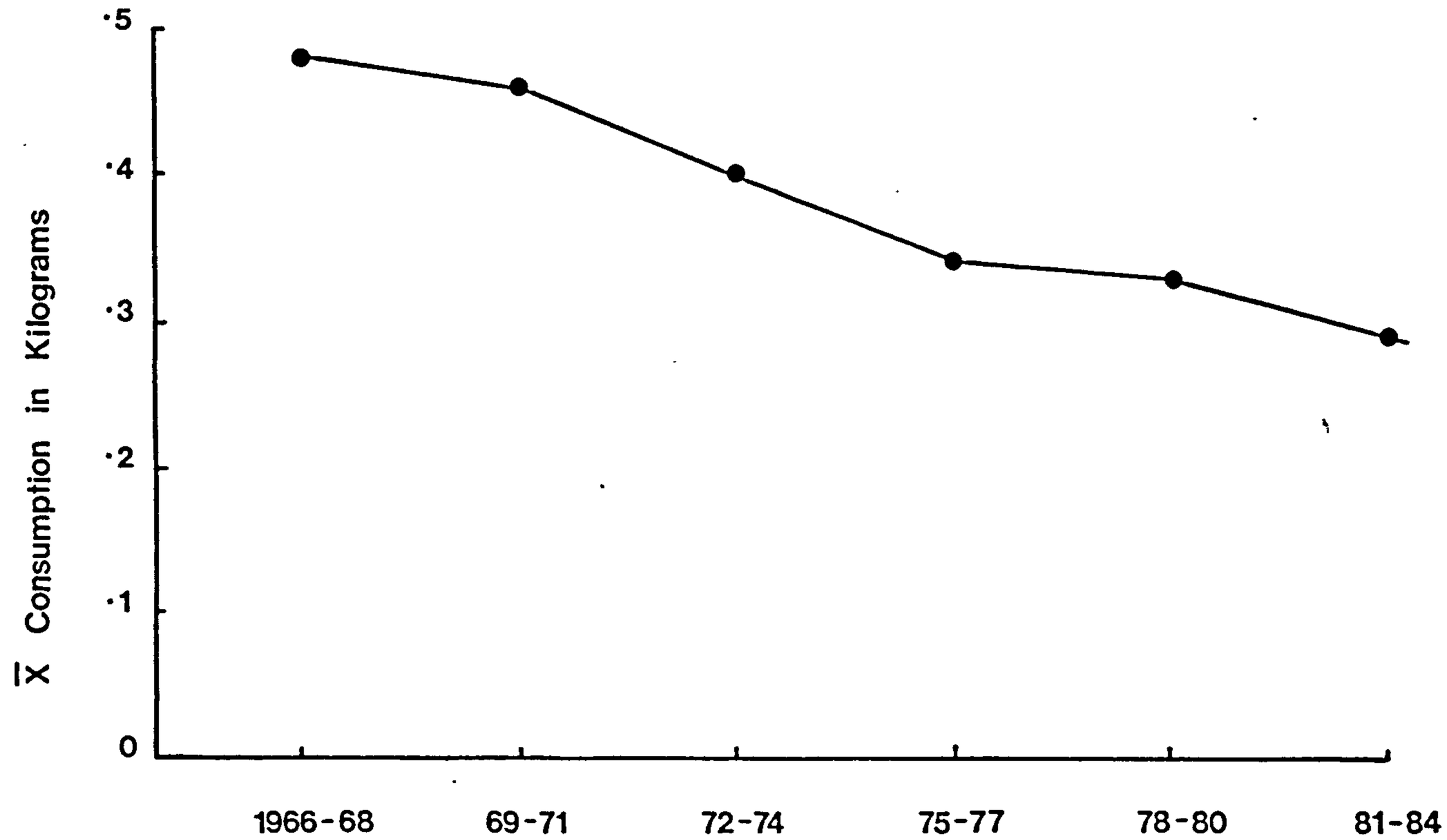


*** p <0·01

SOURCE: NFS

Figure 3.3

MEAN HOUSEHOLD SUGAR CONSUMPTION (KG/PERSON/WEEK)



SOURCE : NFS

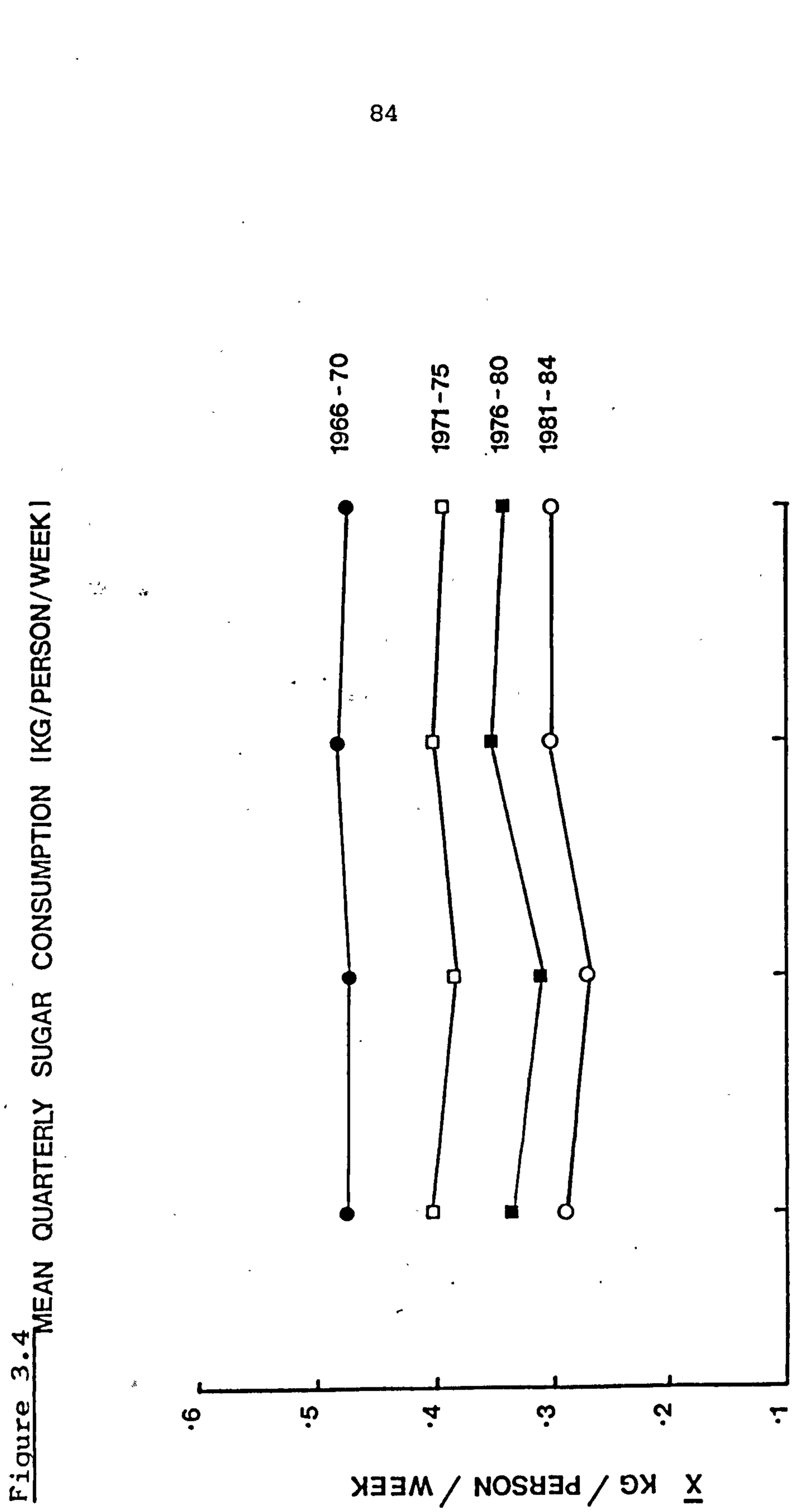


Figure 3.4

SOURCE : NFS

One of the most interesting aspects of household sugar consumption revealed by the NFS is the variation in consumption by gross weekly income of head of households (Table 3.13). This shows that packet consumption is nearly twice as high for OAP's than for income group A during the 1980's. This trend in consumption is reflected throughout the income groups; the lower down the income group, the greater the average weekly sugar intake. The higher income groups have also shown the greatest percent change in sugar consumption between 1980 and 1986 with the 'A' group reducing intake by more than a third (37.4%) and the OAP's by only 12.8%. However, all income groups have shown a large drop in household sugar consumption throughout the first half of the 1980's.

The NFS is also useful for following the household consumption of certain food items that contain sugar as an important ingredient. For cakes, pastries and biscuits, for example, total household consumption fell steadily between 1960 and 1980, although it has remained virtually unchanged throughout the 1980's. For soft drinks, low-calorie consumption doubled between 1984 and 1986 (Table 3.14) without apparently affecting consumption of unconcentrated soft drinks. Since 1975 particulars have been obtained of soft drinks bought for the household supply, but the information on soft drinks is excluded from the main analysis.

TABLE 3.14

HOUSEHOLD CONSUMPTION OF SOFT DRINKS

(PER PERSON/PER WEEK/FL OZ)

Soft Drinks	1984	1985	1986
Concentrated	4.02	3.57	3.45
Unconcentrated	8.65	8.86	9.18
Low-calorie	0.91	1.27	1.90
All Soft drinks	29.66	27.98	28.33

Source: NFS, 1986

TABLE 3.13

CONSUMPTION OF SUGAR AND PRESERVES BY INCOME GROUPS
(OZ PER PERSON PER WEEK)

		Gross weekly income of head of household						
		Household with one or more earner				Household without an earner		OAP
	Year	All A	B	C	D	E1	E2	
Sugar & Preserves	1986	6.86	8.42	9.20	10.41	14.54	13.07	18.52
	1985	7.72	8.16	10.17	11.35	12.52	12.86	17.30
	1984	8.02	9.42	10.90	11.55	15.76	13.35	18.34
	1983	8.61	10.21	11.70	12.41	13.36	15.26	18.44
	1982	10.11	10.35	12.07	14.22	14.32	14.65	18.93
	1981	10.39	11.04	12.95	13.61	18.35	16.82	20.69
	1980	10.95	11.20	13.22	13.80	18.50	17.44	21.34
% change between 1980-1986		-34.4%	-24.8%	-30.4%	-24.6%	-21.4%	-25.1%	-13.2%

Source: National Food Survey, various years

Another point to note regarding sugar and change in household consumption patterns is when sugar is looked at together with total household carbohydrate intake. Sugar still contributes about a fifth of total household carbohydrate even though household consumption of sugar has been falling. Figure 3.5 shows that the total carbohydrate contributed by sugar and preserves almost halved between 1970 and 1984 from 77 grammes to 44 grammes, yet the percentage of total carbohydrate provided by sugar and preserves has remained fairly constant, falling from 24.2% to 21.5% over the same period (Figure 3.6). At the same time the percentage of total energy provided by sugar and preserves fell from around 11.5% to a little over 8%.

3.5.2 Consumption Level Estimates

Like NFS data, Consumption Level Estimates (CLE) are published by the Ministry of Agriculture, Fisheries and Food. CLE figures can be found in issues of "British Business" (formerly the "Board of Trade Journal") and they are estimates of various food items as they enter the food chain or supplies that are available for consumption (also known as disappearance figures). They are therefore, not a direct reflection of actual consumption.

However, the CLE figures for sugar are an accurate guide to the total amount of sugar in the food system. They represent refined and unrefined sugar and 90% of their total is derived from figures supplied to MAFF of weekly deliveries to retail and industrial users of sugar by British Sugar and Tate and Lyle. Also changes in stocks are taken into account as are other sources of supply such as brown sugar imported direct from countries like Mauritius.

Figure 3.7 gives the CLE figures for the past three decades in five year averages. Using Dunnett's T-test this shows that statistically there was a significant increase in sugar supplies moving into consumption from the period

Figure 3.5

TOTAL CARBOHYDRATE (G/PERSON/DAY) CONTRIBUTED BY SUGAR

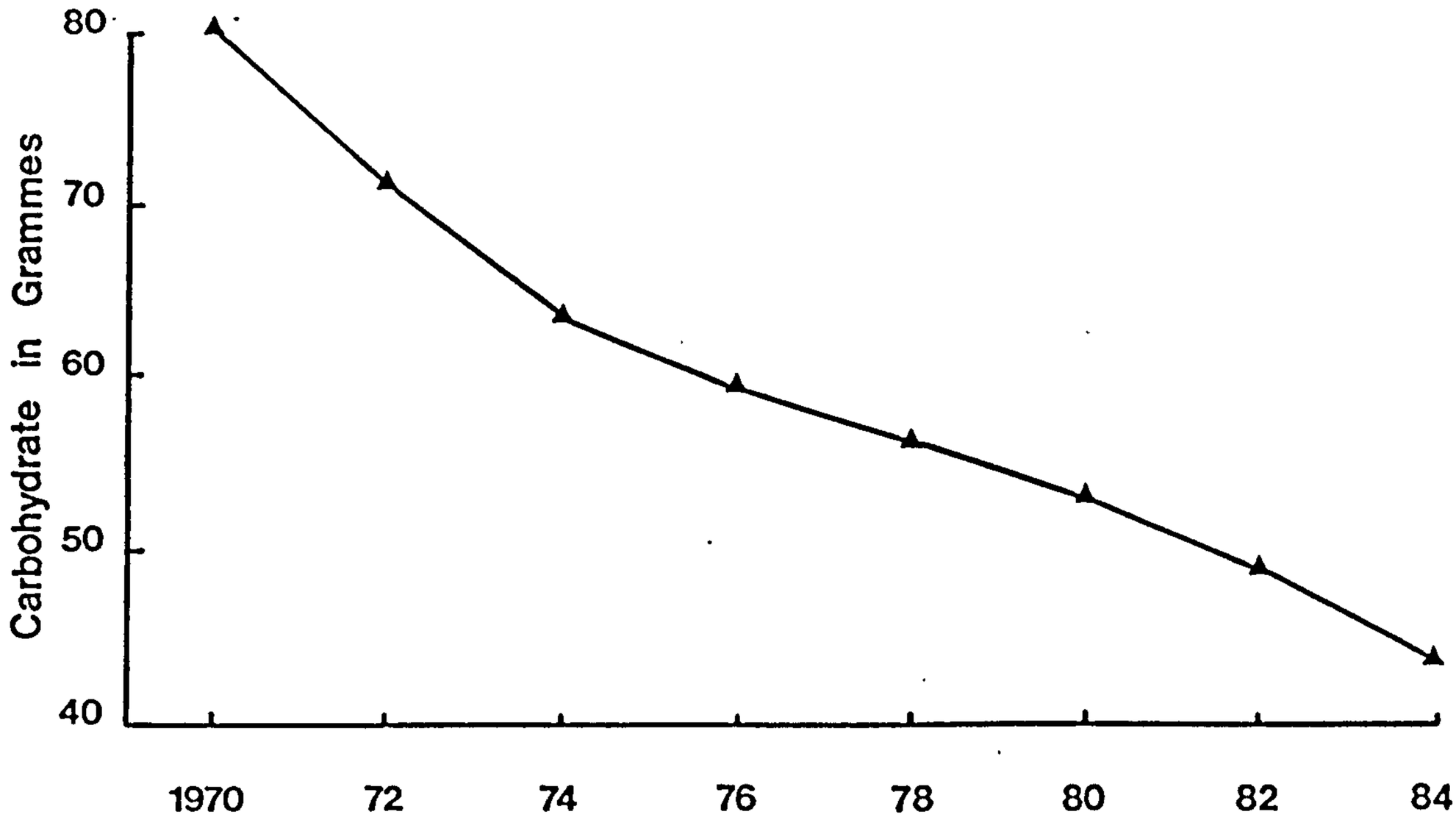
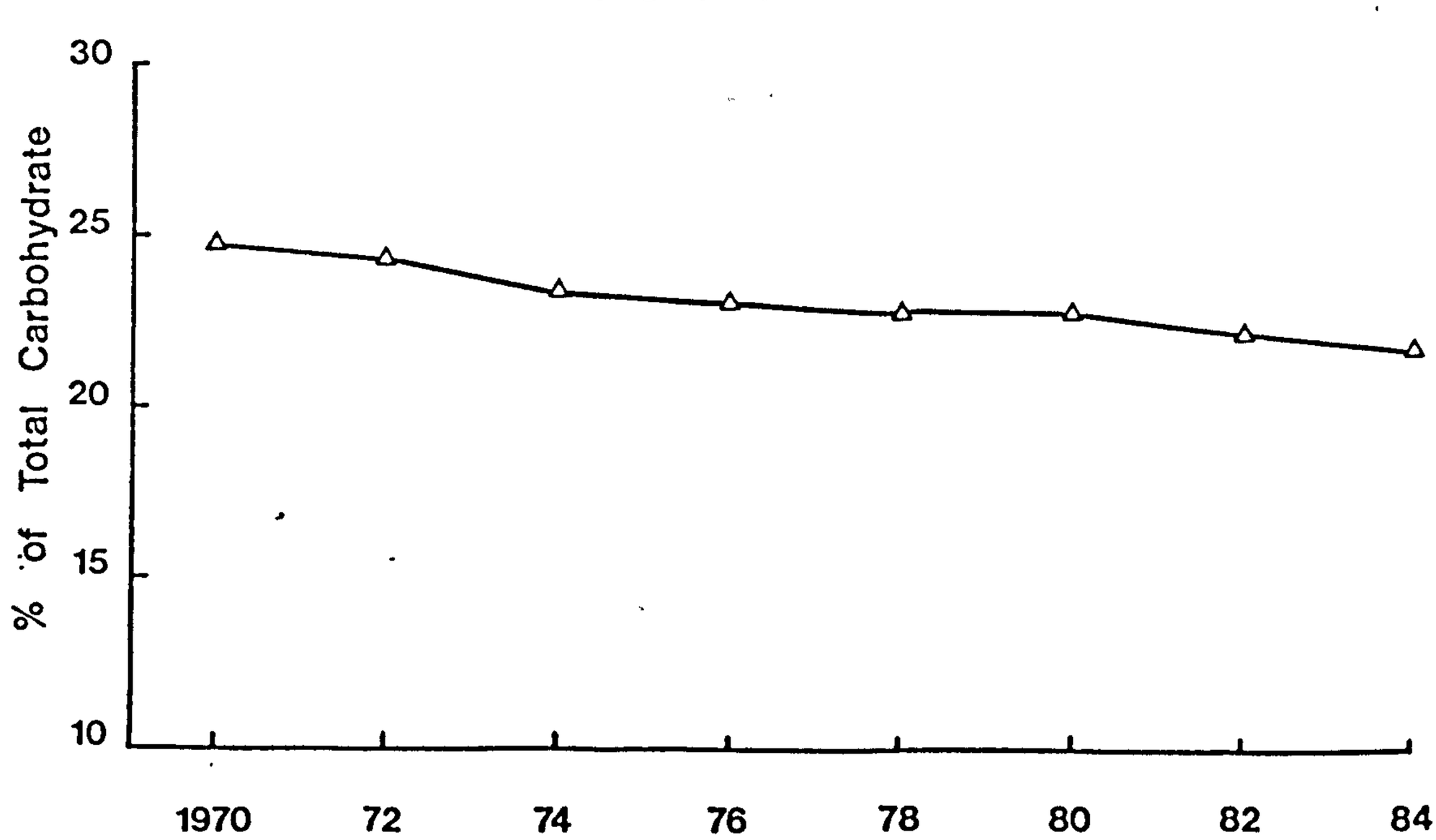


Figure 3.6

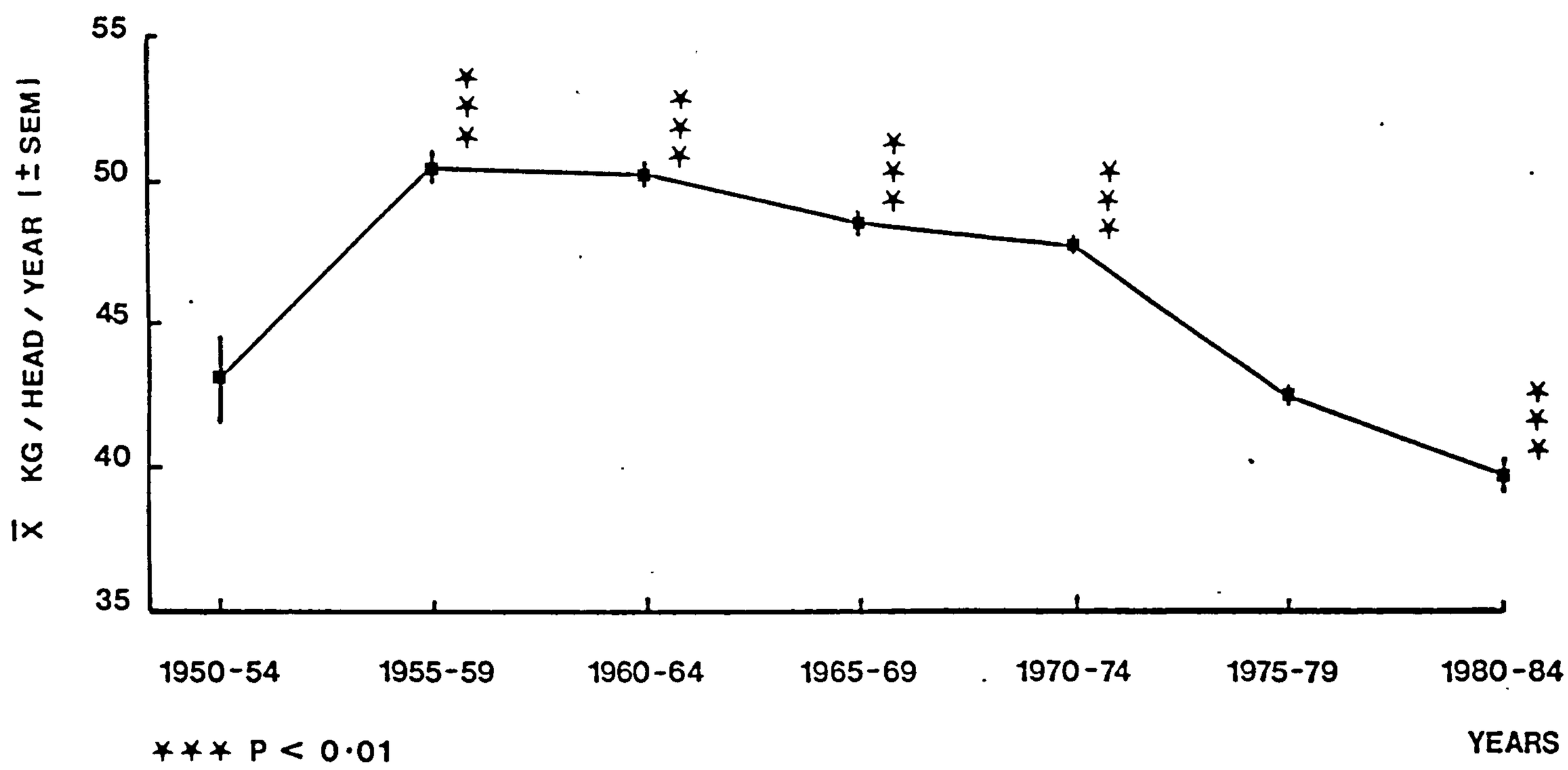
PERCENTAGE OF TOTAL CARBOHYDRATE (G/PERSON/DAY) BY SUGAR



SOURCE : NFS

Figure 3.7

SUGAR SUPPLIES MOVING INTO CONSUMPTION IN THE U.K.



*** P < 0·01

SOURCE: CLE. MAFF

1950-54 until 1970-74. There was no change in 1975-79 and it is only recently (1980-84) that there has been a significant fall in sugar supplies. The CLE figures for sugar between 1980-1986 are:

	1980	1981	1982	1983	1984	1985	1986
kg/per head/per year	37	36.7	39	37.4	37.9	37.1	37.3
equivalent in tonnes, w.s.e.	2,084,210	2,068,118	2,195,934	2,107,378	2,139,834	2,100,528	2,117,26(

3.5.3 Individual Dietary Surveys

More light has been thrown on individual as opposed to national average sugar consumption by a number of dietary surveys. These measure energy and nutrient intakes of individuals by recording all foods eaten over several days. Such measurements are costly in time, motivation and money, but can provide fairly accurate consumption data on given populations. However comparison between these is often difficult for the simple reason that the populations studied are not comparable and the definition of 'sugars' has not been consistent. The other problem is that the analysis of foods eaten is usually based upon "McCance and Widdowson's 'The Composition of Foods' " (Paul and Southgate, 1978). However this book does not give accurate breakdowns of the ingredients (and hence sugar content) of the complex recipes of many processed foods and it was only the fourth edition (1978) that natural sugars, such as lactose found in milk were listed. Table 3.15 summarises the sugar consumption of individuals as reported in a number of post-war surveys. It is difficult to make general statements about these dietary surveys, however, in all cases, on average, men consumed more sugar than women and total sugars accounted for around one-fifth of total daily energy; for only sucrose, this was

TABLE 3.15

SUGAR CONSUMPTION OF INDIVIDUALS ESTIMATED BY DIETARY SURVEYS

Author	Year	Age	Sample Size	Total Sugars Intake (oz per day)	Sucrose Intake (oz per day)	Total Sugars as % Energy	Sucrose as % Energy	kg/per person per year
Yudkin and Roddy	1965	Adults	23 (male and female)	71	-	-	-	25.92
Cook et al	1968-70	8-15	355 males	-	113	-	17	41.25
			341 females	-	90	-	17	32.85
Darhe and Disselduff	1971	10-11	163 males	-	95	-	16	34.68
			158 females	-	85	-	17	31.03
Bingham et al.	1977	20-72	32 males	-	91.0	-	14.3	33.22
			31 females	-	56.7	-	10.9	20.70
Black et al.	1977	20-59	42 females	-	38	-	7.5	13.87
Nelson	1977-79	18-57	105 males	150	-	20	-	54.75
		18-53	112 females	102	-	20	-	37.23
Barber et al.	1980	18-82	40 females	131	-	16	-	47.82
			78 females	83	-	15	-	30.30
Thomson et al.	1980-82	45.54	165 males	141	-	20	-	51.47
Fehilly et al.	1980-83	45-59	665 males	109	-	17	-	39.79
		40-59	49 females	66.5	-	16	-	24.27
Hackett et al.	1979-81	11-14	193 males	124	-	20	-	45.26
			212 females	113	-	21	-	41.25
Bull	1982	45-25	452 males	126	-	19	-	45.26
			461 females	97	-	20	-	41.25
Schofield	1985	18-35	260 females	90	-	16	-	32.85

Source: adapted from British Nutrition Foundation, 1987 and Rugg-Gunn et al., 1986

around 16-17% of total energy. The distinction between men and women is less clear when sugars and sucrose are considered as a per cent of total energy.

Most dietary surveys have not differentiated between 'natural' and 'added' sugars. Few have recorded 'total' sugars consumed that is, the sum of both 'natural' and 'added' sugars. The first survey to report total, natural and added sugars consumed was that carried out by Rugg-Gunn et. al. (1986), when they examined the dietary intake of added and natural sugars in 405 English adolescents. Their results show:

Mean daily intake of sugars

	ADDED SUGARS	NATURAL SUGARS	TOTAL
193 Boys	85g (s.d. 22)	39g (s.d. 12)	124g
212 Girls	78g (s.d. 24)	35g (s.d. 12)	113g

Added sugars contributed, on average, 69% of total sugars which is 15% of energy intake. Confectionery, table sugar and soft drinks together contained 71% of the total added sugars, while milk, fruit and their products produced most of the natural sugars. In this study, the deviation between low and high consumers was large (for example, boys ranged from 63g to 107g).

The study by Black et al. (1984) of the dietary intake of 42 dietitians from 1977 was compared with the NACNE recommendations. The mean daily sucrose intake was only 35g (NACNE long term goal 55g), with 11 dietitians consuming less than 25g a day of sucrose, although it must be remembered, dietitians represent a special population. The five subjects with the highest intakes of sucrose included the only three who took sugar in tea or coffee and the two highest consumers of confectionery.

For the dietitians in this study the main source of sucrose came from that added to foods by the individual. The other sources, (apart from confectionery and table sugar) were cakes, biscuits, puddings and preserves.

However, the differences in terms of food eaten were marginal. The 'high' consumers (more than 50g a day) obtained 7.3g of sucrose from confectionery, 4.5g from mineral drinks and 10.5g from table sugar - equivalent to one-fifth of a Mars bar, half a can of lemonade and two teaspoons of table sugar! It would seem from this study that cutting down on sucrose will mainly depend on eating less confectionery, mineral drinks and sugar in beverages.

In the study by Bingham et al. (1981) the dietary intakes of 63 adults, randomly-selected from the electoral role of a large village near Cambridge, were measured. For sucrose the Mean (+ and - s.d.) daily intake for men and women respectively was 91g (47g) and 57g (33g). Of the total average consumption of all sources of sucrose, (74.1g/day), 40% (31g) was taken as table sugar in drinks and on cereal. Men, however, consumed three times more table sugar than women (men 47g/d, women 14g/d). The range of sucrose intakes was large with some people consuming only 5-10g/d while others took 240g/d. Carbohydrate and sucrose intakes were also correlated with energy intake and, in this study, 13% of energy came from sucrose. These studies suggest there is a wide variability in sugar intake between individuals. However, these intakes are concentrated in very few areas. The Rugg-Gunn et al. study showed that high and low sugar consumers were not eating fundamentally different foods, but that high sugar eaters ate consistently more of certain foodstuffs while low sugar consumers rarely over-indulged in such foods. The sources of sugar most at risk, as suggested by these studies, is table sugar added to foods and beverages, confectionery and soft drinks. It is interesting to note that foods, such as baked beans and tomato ketchup, were relatively unimportant sources of sucrose for the 405 adolescents in the Rugg-Gunn et al. study, and this suggests any changes in the diet as far as these products and sucrose is concerned may be largely superficial.

3.5.4 Commentary

Figure 3.8 shows a comparison between CLE and NFS data on sugar. There is clearly a large difference between the two sets of figures. On average the difference has been fairly consistent at around 25 kilogrammes per person per year (the largest difference, 28.61 kg was in 1974 and the smallest, 22.46 kg in 1980). It is the discrepancy between supply or disappearance data (CLE figures) and household consumption that has led to considerable debate over how much sugar is actually eaten. In other words, just how much of the 25 kilograms difference do people actually eat?

There are some explanations why discrepancies in consumption figures occur, not least the difficulty in collection. For example, the NFS calculations are based on factors which may not be entirely reliable and as mentioned earlier, do not include food consumed away from the home such as soft drinks and confectionery, all sources of sugar consumption. Taking the tonnage figures for soft drinks, chocolate and sugar confectionery (Table 3.10) as delivered to manufacturers, this is equivalent to around 11.69 kg/per person/per year of sugar in just these products and accounts for nearly half this "discrepancy". There is also the complex nature of the food chain. When looking at the NSF/CLE data it is often tempting to assume a simplistic relationship, namely:

FOOD SUPPLY AT NATIONAL LEVEL

FOOD AVAILABLE AT HOUSEHOLD LEVEL

FOOD CONSUMED BY INDIVIDUALS

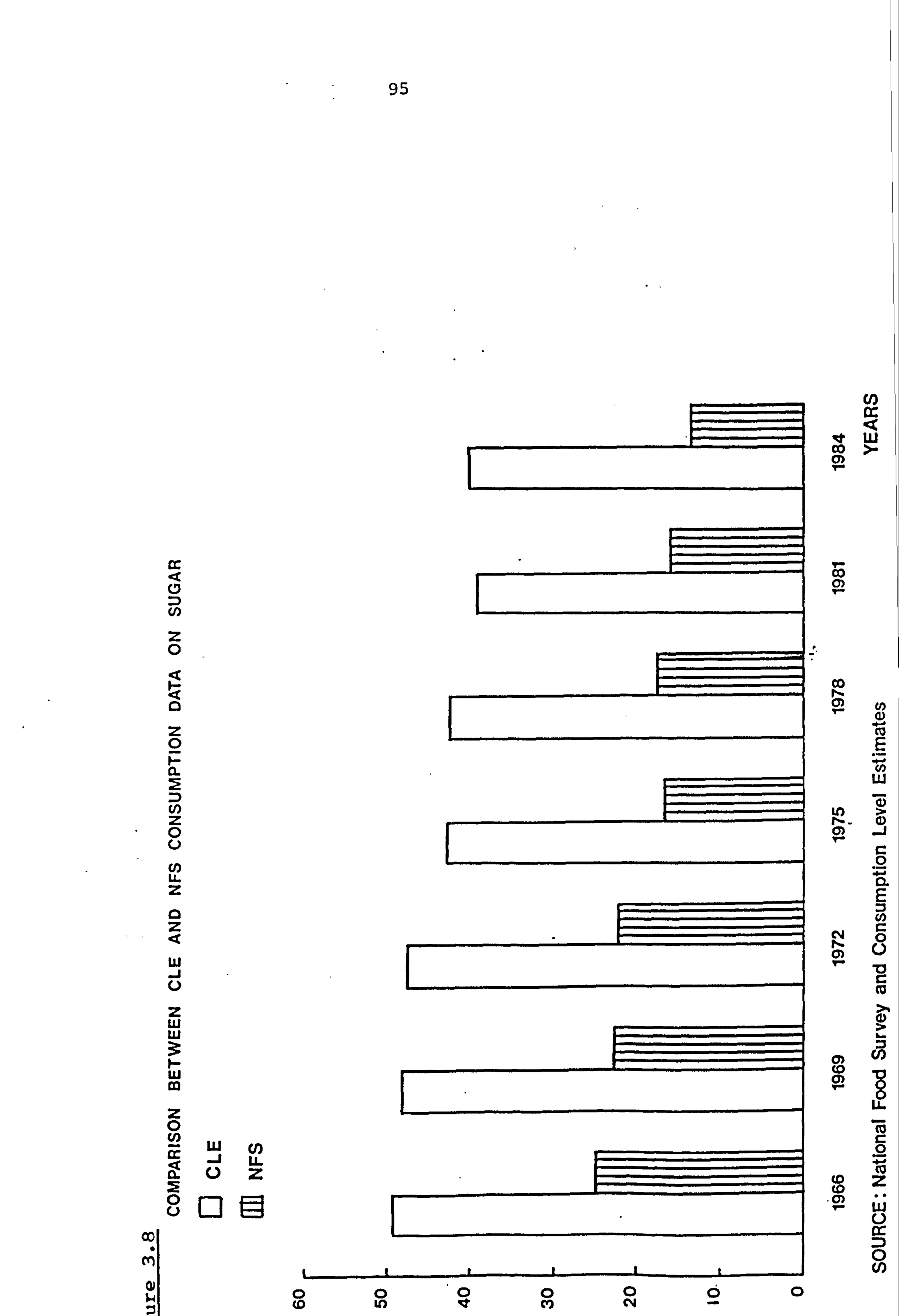

COMPARISON BETWEEN CLE AND NFS CONSUMPTION DATA ON SUGAR
CLE
NFS
KG / HEAD / YEAR
60
50
40
30
20
10
0
1966
1969
1972
1975
1978
1981
1984
YEARS
SOURCE: National Food Survey and Consumption Level Estimates

Figure 3.8

whereas, the food system from producer to consumer is much more complicated as Figure 3.9 illustrates. This shows there are many outlets for a particular food item and many opportunities to consume a particular food as well. There is also the question of wastage. Not only food lost in processing but also in institutions such as hospitals, in private catering (hotels, restaurants, conference halls), in schools, in work canteens as well as the household.

Estimates for this wastage vary. At the level of the whole household this is often assumed to be around 10% and for the CLE sugar figures around 10-15% (Sugar Bureau, private communication). There are also a few surveys and educated guesses about wastage in hospitals, catering and so on, but not specifically for sugar. Even assuming a certain degree of waste there is still the problem of how much sugar an individual will actually consume. Table 3.16 makes a comparison between some of the sources of data mentioned in this section and shows how confusing it can be to draw any general conclusions at the individual level. It also gives some indication of the problems of making comparisons and any hard and fast statements on individual sugar intakes.

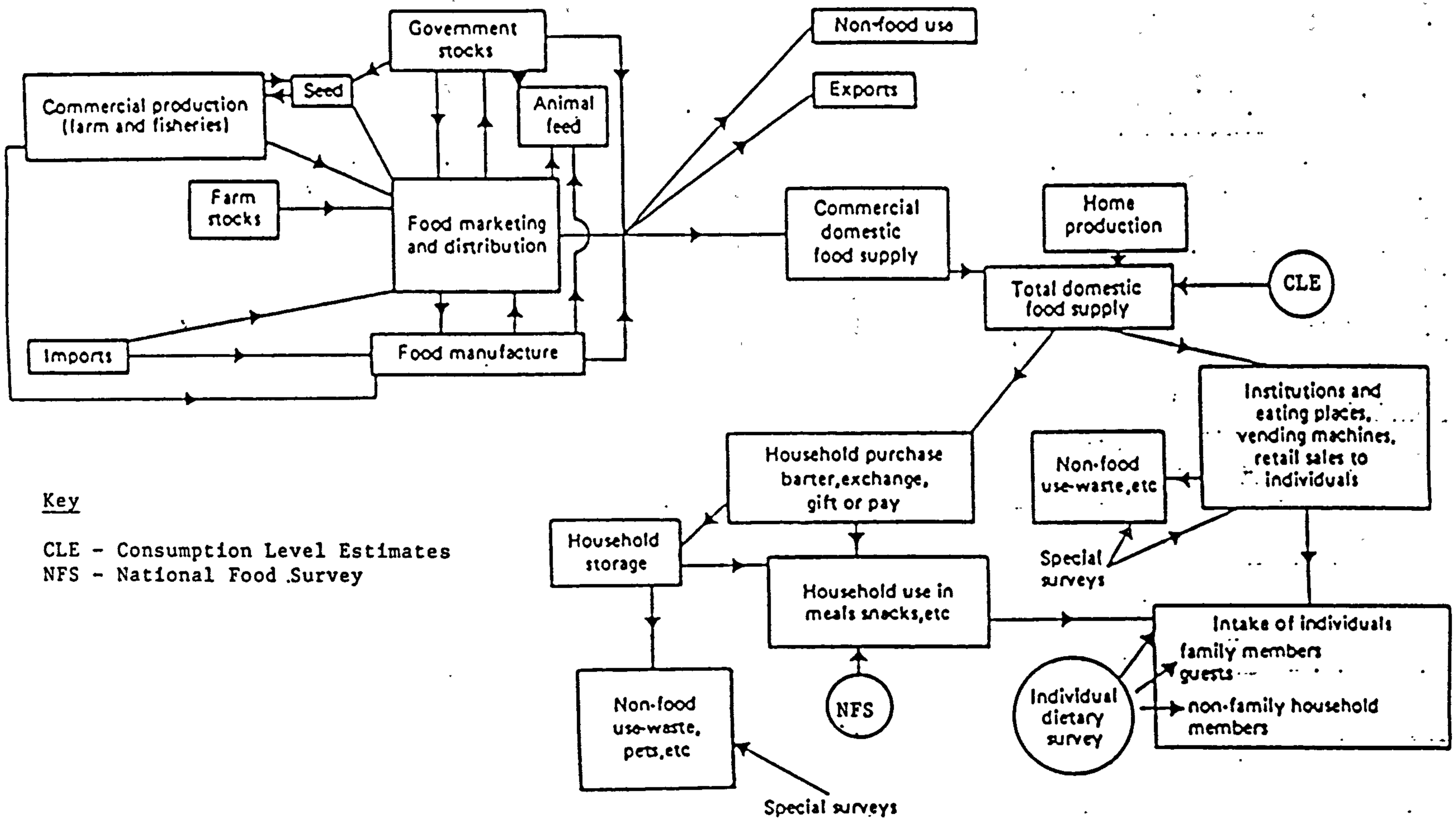
TABLE 3.16

COMPARISON BETWEEN SOURCES OF INFORMATION ABOUT PER CAPITA SUGAR CONSUMPTION

CLE	104g (1984)
NFS	37g (1984)
RUGG-GUNN et al. (1986)	Boys 85g (added sugars) Girls 78g (added sugars)
BLACK et al. (1984)	Dietitians 35g (daily sucrose intake)
BINGHAM et al. (1981)	Men 91g (mean daily intake of sucrose Women 57g (mean daily intake of sucrose)

Figure 3.9

The Food System: flow of food from producer to consumer



Key

CLE - Consumption Level Estimates
NFS - National Food Survey

Source: Adapted from Dowler and Young, 1985

On the other hand, the main sources of sugar in the diet can be easily identified, in particular these are table sugar, soft drinks, sugar and chocolate confectionery and flour and bakery products. As mentioned earlier, the Rugg-Gunn et al. study showed that high sugar consumers did not eat different foods from low sugar consumers, but more of the same foods. In fact one of the most striking features of the individual dietary surveys is the large standard deviations from the means with, in some cases, individuals consuming around 50% more or less than the average.

There is a distinct lack of information on individual sugar and sweeteners intake. However, it is plausible to suggest that the CLE figure is not an accurate base from which to recommend a reduction. The reason being, this takes no account of the variability in individual intakes. Implicit in this is that national dietary guidelines for sugar based on CLE data are not very useful. It seems more logical to recommend a specific figure of intake over which an individual should not exceed and give the reasons for this (the NACNE report gives this figure as 20kg per person per year) rather than make the statement that consumption should be reduced. This might form a more useful base for health education on sugar.

3.6 Recent Factors Affecting Sugar Consumption in the Market Place

3.6.1 Introduction

The past five years has seen a rapid growth in nutritional advice, health books, articles, TV programmes and academic research in the area of food, diet and health, much of it aimed at the general public. Market research now suggests that "healthy eating" is not a fad, that is, a regimen pursued for a short time and then discarded, but is here to stay (D'Arcy, Masius, Benton and Bowles, 1986; Taylor Nelson, 1987). In response to this, many food companies have made changes to their products or have introduced new ones. Some of

this attention to food, diet and health has been directly relevant to sugar.

Where diet-related ill-health and disease are usually manifested over a long time span, the changes in today's market place are extremely rapid, despite the longevity of some brands (for example, the 'Milky Bar Kid' was 25 years old on TV in 1986 and the Milky Bar itself celebrated its 50th birthday in 1987).

Demand for food is affected by price, availability, quality and appearance. These are important in the market place, but there are many reasons or combinations of reasons that finally influence consumer choice and are thus crucial to the success or failure of a product. This section examines some of the factors that may influence sugar consumption and sales of products that contain sugar as an ingredient. These are examined under the following headings:

* consumer attitudes to sugar
* popular education
* the power of the retailers

The use of other sugars and sweeteners and the response by food manufacturers will be considered in the next Chapter.

3.6.2 Factor One: Consumer Attitudes to Sugar

Consumer attitudes can be very fickle, but, as far as sugar is concerned people are quite opinionated and definite about it: they don't like sugar very much. The following sections look at qualitative and quantitative work into consumer attitudes that gives rise to this conclusion.

3.6.2.1 Qualitative Research

Three discussion groups were held in early 1986 with shoppers at Morrisons supermarkets in Bradford, Rochdale and Sheffield. These were

organised by Food Policy Research, University of Bradford, including the author in May 1986. Recruitment was undertaken at the supermarkets at which the discussions were to take place. Shoppers were approached and given an explanatory letter as well as verbal explanation, if they were interested in attending. The discussions were held in in-store training rooms and each group session lasted between one and one and a half hours. Table 3.17 gives the profile of shoppers taking part in the discussions.

TABLE 3.17

PROFILE OF MEMBERS OF MAY 1986 DISCUSSION GROUPS

		Age Group
Bradford	2 female	25-34 years
	2 female	35-54 years
	1 man	25-34 years
Sheffield	4 women	25-34 years
	6 women	35-55 years
	4 women	55+ years
	1 man	35-54 years
Rochdale	5 women	25-34 years
	7 women	35-54 years
	3 women	55+ years

All the discussions were unstructured and centred around the issue of diet and health. In general, the majority of consumers who took part were aware of "healthy eating" issues and many were taking active steps to make changes in their family's or their own diets. In some cases people were extremely well informed on dietary issues (Slattery and Wright, 1986).

At one discussion group held in Bradford, sugar was generally considered 'bad for you', particularly for children as a cause of tooth decay. Most of the group did not add sugar to drinks, although one used an artificial sweetener. Sugar was specifically mentioned as a food that was avoided. One shopper said she now used less sugar in baking and her family had become used to less sweet foods.

The Rochdale discussion group was very much the same. Most had reduced the amount of sugar in their diet but were worried about the amount of sugar 'hidden' in manufactured food. It was thought best if children's diets contained as little sugar as practicable.

Again Sheffield confirmed these views. Shoppers thought most diets contain too much sugar, especially in the form of manufactured foods, although many were not aware which foods contain added sugar. Sugar was thought of as an important food item to cut down on in slimming diets and for this reason should be noted on food labels. In all three discussion groups, sugar was talked about in a negative context and as a food item to reduce or be careful about over-eating.

In a qualitative evaluation of the Tesco 'Healthy Eating Programme' and its impact upon consumer attitudes and purchasing patterns carried out with shoppers at two Tesco stores, sugar again was an item of food the majority had or were attempting to cut back on eating (Freckleton, 1986).

The older participants mentioned having reduced sugar consumption as part of their 'war effort', while others quoted the sugar shortages of the 1970's. Although some had found it difficult to implement reduction of their sugar intake, others remarked upon the ease with which a reduction had been achieved and how much better things tasted. Indeed, some said 'bought' goods often seemed too sweet.

> "I buy fruit in natural juices, once you've had them you don't want the ones in syrup."

Several Tesco shoppers had specified health reasons for cutting back on sugar consumption. These were diabetes and concern about dental disease. On the whole, the majority saw sugar as something unnecessary in their diets, and generally felt that it was 'bad' for them:

> "After all, it's only empty calories."

Tesco shoppers thought the main way to reduce sugar intakes was to cut back on confectionery, cakes and biscuits and to stop adding sugar to drinks and cereals. A number were using artificial sweeteners or alternatives or buying low-calorie products, which were often considered 'too sweet'. In the main, Tesco shoppers felt they had been successful in their attempts to reduce sugar in their diet.

Increasingly, it seemed that the majority considered there was too much sugar in products and that manufacturers were slow to realise that consumer tastes were changing:

> "they've been established so long they use the same recipe and they haven't adapted to the fact that people are changing, so they don't change or use alternatives."

Consumer attitudes, in general, are unfavourable to sugar especially as white packet sugar. However, it is not so clear how it was perceived when used as an ingredient in food.

3.6.2.2 Quantitative Research

In 1985, the British Nutrition Foundation decided to find out if the message to change to a healthier diet was having an impact on the public (BNF, 1985). From their study confectionery, sugar, chips, eggs, jam, biscuits, cream, were cited as foods whose consumption should be reduced. However, it was estimated that only 10% of housewives were 'believers', committed to a healthier diet and particularly conscious of what they ate.

Research by Cameron, Choat and Partners suggests that this figure rose to 20% by 1986. Managing Director, Jonathon Choat said:

> "Consumers are being encouraged by a whole raft of new magazines, from the 'foodies' titles to the healthy Lifestyle titles... the damp squib of healthy eating is about to take off like a rocket." ('Marketing' July 17, 1986)

Changes to a more 'healthy' diet invariably includes concern about sugar

consumption. The advertising agency D'Arcy, Masius, Benton and Bowles conducted a major survey on attitudes to diet and health involving 6,000 housewives. They identified six distinct groups as determined by their attitudes towards healthy eating. These were 'superfits', 'younger concerned', 'older concerned', 'older apathetics', 'younger apathetics' and 'grannies'.

Their results showed that about half of the housewives in Britain are actually making alterations in their patterns of food consumption because of health concerns. The foods losing sales as a result were dairy products, salt, meat, sugar and products with additives and perservatives ('The Times' January 18, 1986).

Nigel Clarke, planning and research director of D'Arcy, Masius, Benton and Bowles said:

> "The situation has not quite been reached where there is a social stigma attached to being the sort of person who doesn't take care to feed the family healthily, but the movement of opinion is in that direction.
>
> The development of a social dimension to what started as a dietary preoccupation will undoubtedly embed their new eating habits in people's lives. The healthy eating movement will go further - but primarily among those who are already involved." ('Marketing' November 28, 1985)

On this advertising agency's research that is half of all housewives.

NOP Market Research Limited has done some work on 'Healthy Eating' and the consumer (published in 'Marketing Pocket Book', 1986). Their results are summarized in Table 3.18. These opinions suggest that a wide range of foods are considered as 'better' to eat. Sugar is the one food product more than half of women and 40% of men are trying to reduce. Sweets also fare badly with a third of men and 43% of women trying to eat less, however, there is no information on success rate.

In a report 'I Know What's Good For Me', for the Presto Division of Argyll Stores (Table 3.19), among the food surveyed, white sugar was ranked

TABLE 3.18

CONSUMERS' ATTITUDES TO WHAT CONSTITUTES A HEALTHY DIET

	Men	Women
	%	%
Persons over 15 who try to eat fewer sweets	33	43
Drink low calorie soft drinks	8	17
Eat wholemeal bread rather than white	34	46
Eat less fat	37	47
Eat less meat	10	21
Use low fat or skimmed milk	14	23
Use low fat spread instead of butter	21	30
Eat less cream	15	25
Grill rather than fry food	39	57
Cut down on salt	26	37
Eat more fresh fruit and vegetables	47	65
Increase the amount of fibre in diet	23	32
Avoid food containing additives/preservatives/ artificial colourings	17	27
Eat more 'natural' foods and avoid processed foods	26	38
Cut down on sugar	40	55
Eat a balanced diet generally	38	50
Eat breakfast cereals with a high bran content	23	30
Take vitamin pills	6	10

Source: NOP Market Research Limited "Consumerism", April 1985 published in "Marketing Pocket Book", 1986

TABLE 3.19

FOODS BEING PERCEIVED "FAIRLY BAD" OR "VERY BAD"

	% Perceiving "fairly bad" or "very bad"
Salt	54
Crisps	54
Chocolate	56
Sweet Biscuits	61
Ready-made Pizza	57
Frozen beefburgers	61
White Sugar	64
Ready-made Lasagne	57
Hamburgers such as McDonalds, Wimpy, Burger King	75

Source: KMS Partnership Ltd., 1984, in "I Know What's Good For Me" a Report for the Presto Division of Argyll Stores

highest as being perceived as 'fairly bad' or 'very bad'. Chocolate and sweet biscuits were also singled out by more than half of the respondents as belonging to the same categories.

A survey involving more than 1,000 housewives commissioned by St. Ivel, found housewives have a growing knowledge of healthier diets and actively consider and pre-plan what they are going to eat (reported in 'Super Marketing', October 3, 1986). In this survey sugar was seen as the greatest problem with 79% of housewives naming it as "the food important to eat less of", with fat in second place with 69% and colouring, preservatives, salt at 68%, 68% and 67% respectively.

In a survey conducted by Food Policy Research into consumer attitudes (unpublished, 1986) a number of questions were included relating to sugar (Tables 3.20-3.25). These confirm these negative attitudes towards sugar. Out of 576 female respondents, more than two-thirds recognized that sugar is a good source of energy (although a third thought it was not), but despite this large majorities, 86% and 92%, agreed that there is too much sugar used in food manufacturing (Table 3.23) and children should eat less foods containing sugar (Table 3.21).

More than 60% of respondents agreed with the statement 'I don't think eating sugar is any good for you at all' (Table 3.24), although they were split nearly half and half over whether they had too much sugar in their diets (Table 3.25). In the debate over whether brown sugar is better than white, brown sugar still comes out on top (Table 3.22) with just over half agreeing to the statement, but a third disagreed and a significant number don't know. Further, the more general trend to "better" eating has been reported in a recent survey among consumers (n=1416) which concluded:

> "Encouragingly for health promoters, trends in dietary attitudes and behaviour are clearly in the direction recommended by health professionals and health educators. Many people are eating less

meat, sugar and eggs, more fruit and vegetables, grilling rather than frying their food, drinking more semi- or skimmed milk, and eating more wholemeal than white bread. The main reasons for changing eating habits appear to be to improve or maintain health and to keep slim. This is manifested in positive attitudes to natural foods such as fruit and vegetables, and negative attitudes to sugar and animal fats." (Sheiham and Marmot, 1987)

3.6.3 Factor Two: Popular Education

There has been an abundance of 'health education' and attempts to popularize dietary guidelines. Sometimes changing dietary habits have been evangelized as the panacea for the nation's ills. Whatever the quality, detail and authority, it seems fair to comment that, collectively, the spread and growth of nutritional advice especially in the mass media, has been considerable and far reaching.

One of the most informative and comprehensive coverages of diet and health issues has been the BBC's Food and Health Campaign. This was launched by BBC Education in the Autumn of 1985 and gave practical advice about the established links between diet and health. The Campaign included the following multi-media presentation of the subject:

Television series: "O'Donnell investigates: The Food Connection", produced by David Cordingley. Part 1 first transmitted on BBC 1 and 2 from September 1985; Part 2 first transmitted on BBC 2 from February 1986.

"The Taste of Health", produced by Jenny Rogers. First transmitted on BBC 2 from September 1985.

"You Are What You Eat", produced by Anna Jackson. First transmitted on BBC 1 from February 1986.

TABLE 3.20

"SUGAR IS A GOOD SOURCE OF ENERGY"

	%	
Strongly agree	29.4)	68.6
Slightly agree	39.2)	
Don't Know	1.8	
No Opinion	2.2	
Slightly disagree	16.2)	26.9
Strongly disagree	10.7)	
	Base 576	

TABLE 3.21

"CHILDREN SHOULD EAT LESS FOODS CONTAINING SUGAR"

	%	
Strongly agree	69.6)	92.4
Slightly agree	22.8)	
Don't know	1.3	
No Opinion	0.7	
Slightly disagree	2.7)	5.1
Strongly disagree	2.4)	
	Base 576	

TABLE 3.22

"BROWN SUGAR IS BETTER FOR YOU THAN WHITE SUGAR"

	%	
Strongly agree	59.1)	86.6
Slightly agree	27.5)	
Don't know	6.9	
No Opinion	9	
Slightly disagree	2.7)	4.9
Strongly disagree	2.2)	
	Base 576	

TABLE 3.23

"THERE IS TOO MUCH SUGAR USED IN FOOD MANUFACTURING"

	%	
Strongly agree	59.1)	
Slightly agree	27.5)	86.6
Don't know	6.9	
No opinion	9	
Slightly disagree	2.7)	
Strongly disagree	2.2)	4.9
	Base 576	

TABLE 3.24

"I DON'T THINK EATING SUGAR IS ANY GOOD FOR YOU AT ALL"

	%	
Strongly agree	27.2)	
Slightly agree	33.9)	61.1
Don't know	2.7	
No opinion	1.8	
Slightly disagree	26.0)	
Strongly disagree	8.4)	34.4
	Base 576	

TABLE 3.25

"I THINK I HAVE TOO MUCH SUGAR IN MY DIET"

	%	
Strongly agree	17.7)	
Slightly agree	29.2)	46.9
Don't know	2.3	
No opinion	1.6	
Slightly disagree	22.0)	
Strongly disagree	27.1)	49.1
	Base 576	

Radio series: "Not Another Diet Programme", produced by Sarah Rowlands. First transmitted on Radio 4 in early 1986.

BBC Publications: "The Food Connection: The BBC Guide to Healthy Eating" by Colin Tudge, 1985.

"The Taste of Health: The BBC Guide to Healthy Cooking", edited by Jenny Rogers, 1986.

On January 26, 1986, BBC 1 broadcast a programme in the "You Are What You Eat" series entitled 'Sweet Nothing' which was exclusively about sugar and its effects on health. The Sugar Bureau, funded by the U.K. sugar industry, complained that the programme was unjust and unfair in that it contained a totally biased attack on sugar. The complaint was referred to The Broadcasting Complaints Commission (BCC).

In its adjudication, released on October 14, 1987 with a summary published in the Radio Times for the week October 31-November 6 and broadcast on BBC 1 at 6.25pm on Sunday, November 1, the BCC rejected the complaint from the Sugar Bureau. The BCC commented:

> "The Commission consider that the programme's messages, namely that the average amount of sugar consumed per head in Britain is bad for health, especially teeth, and that people should reduce their intake, was in the public interest. Some of the statements in the programme, about which the Sugar Bureau complained, were necessarily generalised. The Commission do not consider, however, that any of the statements were inaccurate or in the circumstances, unjustified. It appears to the Commission that the views presented in the programme represented the consensus of opinion on sugar and health in this country"

There has also been extensive coverage on other television channels, in magazines, newspapers, radio and books on diet and health. Sugar has been a

popular item of media coverage and in the main this has been far from favourable to sugar.

In addition to media coverage, there have been official publications such as the Health Education Council's (HEC) guide to healthy eating, published in 1986. This publication does not mince its words when talking about sugar.

> "Almost any other food you could name would bring some goodness, but sugar is more like a laboratory chemical than a food. All the goodness that went into the original sugar plant is stripped out in the processing."

It then goes on to give 'Tips' on ways to cut down on sugar intake. These are:

* Drinking tea or coffee without sugar

* Choose low-calorie soft drinks or unsweetened fruit juices

* Buying tinned fruit in natural juice rather than in syrup

* Reducing the sugar used in recipes

* Avoiding breakfast cereals with added sugars

* Using fresh fruit or unsalted nuts as snacks instead of sweet or chocolate

* Going easy on cakes and biscuits

If this sort of advice was heeded, it would mean a considerable reduction in sugar intakes. If only partially implemented, it still means a fall in sugar eating. However, in the new edition of the Health Education Council's healthy eating guide published in April 1987, the warning to cut sugar consumption by half has been dropped. The new eating guide was the HEC's final production before it was replaced by the Health Education Authority.

The last minute decision to leave out the central recommendation on sugar is:

> "being seen by senior HEC sources as a victory for the sugar lobby and a severe setback to efforts to tackle obesity." (The Guardian, March 13, 1987)

There are also 'grass roots' movements towards changing dietary habits. For

example, many local authorities have drawn up or are preparing food and health policies which take on board dietary recommendations, including eating less sugar.

The majority of district health authorities already have nutritional policies for groups such as infants and the elderly, but the more recent development of broad-brush local food and health policies represents a comprehensive strategy aimed at promoting dietary change which is applicable to the community as a whole.

The current state of local food and health policy development shows a considerable change from that of earlier years. In 1983 only 16 district health authorities had a formal policy and 58 were in the process of preparing one. By August 1985, 66 local authorities had a formal policy and a further 77 were in the process of preparing one. As a study found:

> "Actions currently underway in many of Britain's hospitals and other parts of the health service are increasing promotion of dietary habits as a contributor of good health." (Montague, 1985)

3.6.4 Factor Three: "Healthy Eating" Initiatives by Large Retailers

Retailers have been quick to capitalize on the healthy eating boom and as such are key players influencing consumer choice. It is on their premises after all that the consumer finally decides what to purchase.

Almost all major retailers have adopted 'healthy eating' marketing strategies to try and capture the changing tastes of shoppers (Freckleton, 1988). Retailers have particular strength in their range of own label or generic products. The food industry is capable of rapid change and it seems almost overnight that "low" and "high" and "free from" and "contains no" claims appeared in the supermarket; these changes, incidentally, also testify to the impact of current nutritional thinking.

The large retailers have been exerting increasing power in the food market place. By 'power' is meant the change that has occurred over the past 20 years in the relationship between food manufacturers and food retailers.

Four retailers now account for 50% of trade from the fast moving consumer goods companies and seven for 65% ('Marketing', July 24, 1986). According to Verdict Research (cited in "Financial Times", September 19, 1988) the U.K. grocers' market shares for 1987/88 are as follows:

	%
Tesco	14.0
Sainsbury	13.9
Dee	11.5
Argyll	10.7
Asda	7.6
Co-Op	12.1

If a new food product does not obtain national distribution through at least four of the six major multiple groups it stands little chance of success (Shiel, 1979).

If a retailer decides it does not want sugar in a product or believes a product low in sugar would prove advantageous to sales, it is in a very strong position to make these choices on behalf of its customers. The large retailers now stock a wide range of "healthy eating" own label products, including those with reduced sugar. It is interesting to note that the emphasis in some cases is not so much 'low calorie' but actually 'sugar free'. These products are put next to standard selections so inviting customers to make comparisons and choices.

Nearly all major supermarkets have adopted one or more strategies to give their store a "healthy eating" image. Sainsbury's, Argyll-Presto, Asda and Safeway, for example, have all introduced nutritional labelling on their own label products and some use shelf flashes as well.

One of the most recent and far reaching initiatives regarding sugar has been the Co-Op's move to print warnings linking sugar with tooth decay. The warnings advising people to clean their teeth 'soon after eating sweets' because sugar 'may cause tooth decay', appear on own-label sweets made for the Co-Operative Wholesale Society ('Marketing', April 2, 1987).

Not only are retailers influencing the ingredients in the products on their shelves - for example, Tesco has a declared aim of reducing sugar levels in

products under development and has already launched own-label reduced sugar cereals - they also provide a great deal of information about food. This is done on food labels and in literature and posters, in the store itself.

Tesco has also been busy in this latter respect. As part of their in-store 'healthy eating' campaign, they have produced four 'healthy eating' guides and five food fact sheets. The campaign won the Evian Health Award for helping to give consumers a better understanding of nutrition. One of the fact sheets was devoted exclusively to sugar (see Fig. 3.10). This was a guide to the place of sugar in the diet and gives some ideas on how to keep an eye on sugar intakes.

By January 1987 more than 5 million 'healthy eating' leaflets and guides had been distributed throughout Tesco stores.

The Morrison supermarket chain in the North of England developed a "less sugar" symbol as part of their 'healthy eating' campaign. This was displayed prominently on shelves and designed to show shoppers which foods are without sugar as a major ingredient. They also produced a booklet which again contained information on sugar. By 1986, 500,000 copies of this guide had been printed and distributed. This gives some indication of the popularity among shoppers of healthy eating literature. This literature is also being used by health educators and teachers. Figure 3.11 illustrates the advice about sugar consumption from the booklet.

Collectively, the retailers can put a particular message across to many millions of shoppers. This has happened in the case of sugar, the message being: be careful of the amount of sugar in your diet. By closely monitoring sales of sugar-based and sugar-reduced products, it may be possible to assess just how powerful this message has been.

3.6.5 Factor Six: The Sugar Industry

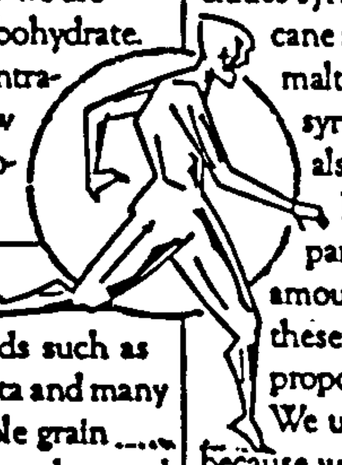
The sugar industry has obviously been responding to changes in the market place, although traditionally sugar as such (except speciality sugars) is not promoted. Most sugar is consumed as part of products and these products,

Figure 3.10 Tesco's "Healthy Eating" advice on sugar

In the introductory Tesco Guide to Healthy Eating we discussed what changes could be made to the diet to make it more healthy. The recommendations were to eat more fibre-rich carbohydrate foods and to eat less fat, salt and sugar. The subject of this guide is sugar.

WHAT IS SUGAR?

In nutrition terms sugar is a carbohydrate. In the past the word carbohydrate suffered a bad reputation as a slimmer's nightmare, full of calories. Now we are recommended to eat more carbohydrate. To understand this seeming contradiction, it is important to know that there are two types of carbohydrates – starches and sugars.



STARCHES

Starches are found in foods such as breads, pulses, cereals, rice, pasta and many fruits and vegetables. The whole grain ..... varieties of bread and cereals, pulses and certain fruit and vegetables are also the fibre-rich carbohydrate foods that we are recommended to eat more of.

Yes, starchy carbohydrates do provide calories – but so do all foods. Energy is vital to our bodies to enable us to move, to think, even to breathe! However, it is important to choose a variety of foods that give us not only energy but the other nutrients we need for good health. Starchy carbohydrate foods give us a wide range of nutrients including protein, iron and the B vitamins, but a relatively small number of calories.

So, contrary to old fashioned ideas, these carbohydrate foods are not fattening if eaten sensibly and we should be trying to include more of them in our diet.

SUGARS

Most of us think of sugar as the white or brown varieties that we buy in the shops. This type of sugar, or sucrose, occurs naturally in sugar cane and sugar beet, it is extracted then processed to produce the pure sugar product we are familiar with.

But white and brown sugar are only part of a whole family of sugars which includes syrup, honey, treacle, molasses, raw cane sugar, dextrose, glucose, fructose, maltose, corn syrup and the glucose syrups used in industry. Sugars are also found naturally in foods.

Fruit juices and dried fruits, in particular, contain quite a large amount of fructose, but in general these sugars make up a relatively small proportion of the total sugars we eat.

We use sugar in all its different forms because we simply like sweet foods. Sugars are also used commercially to improve the texture of food by helping it stay moist, to delay spoilage and to give a golden caramel colour. On average each of us consumes nearly 100 lb of sugars in all their different forms every year – 30 teaspoons a day. Just think, 2 teaspoons of jam or marmalade on your toast every morning adds up to nearly 8 lb of sugar a year!

IS ONE SUGAR DIFFERENT FROM ANOTHER?

Despite the many types of sugar no one sugar has any nutritional advantage over another. Your choice should be based on your taste preference, not on any belief that some are 'healthier' than others. Apart from energy, none have nutrients of any significance and they all contain about the same number of calories, around 16 per teaspoon.

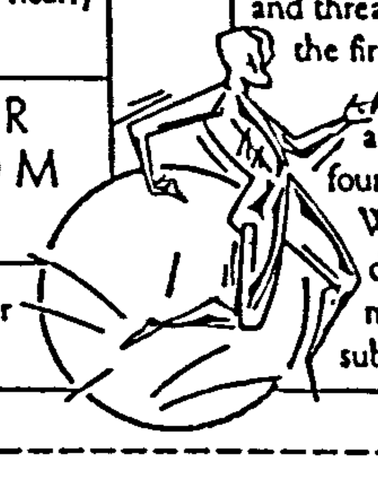
According to some enthusiasts, honey and treacle come into the 'healthy' category. This is not true, as any nutrients present are in very small quantities in relation to the number of calories you also get.

SHOULD WE CUT DOWN ON SUGARS?

Why cut down when we often hear that sugar is a good source of energy? Remember that energy equals calories, and our calories should be from a variety of foods that supply us with other nutrients as well. Over the years much research and debate has centred around the link between sugars and certain health problems and it is now accepted that they can contribute to tooth decay and being overweight.

TOOTH DECAY

Warnings of eating too many sweets and threats of a visit to the dentist must be the first health education message most children receive. Even so, the average 12 year old in the UK has four teeth decayed, missing or filled!



What role do sugars play in tooth decay? We all have bacteria in our mouths which produce a sticky substance called plaque that adheres to our teeth. The bacteria in plaque feed on sugars and produce acid which eats away at the tooth enamel and causes cavities.

The quantity of sugar we eat is less of a problem in tooth decay than how often we eat it and how sticky the food is. Foods like biscuits, dried fruit and sweets which

SUGAR CHART

Serving Size	Food	Quantity added Sugars/Serving
1 tsp (4g)	Sugar – all kinds	1 tsp
SWEETS & SNACKS		
10 sweets (50g)	Liquorice Allsorts	10½ tsp
10 sweets (50g)	Wine Gums	11 tsp
1 small bar (50g)	Chocolate Bar	7½ tsp
BREAKFAST CEREALS		
7 tbsp (50g)	Sweetened Muesli	1 tsp
5 tbsp (30g)	Breakfast Bran	1 tsp
5 tbsp (30g)	Cornflakes	½ tsp
5 tbsp (30g)	Honey 'N' Nut Cornflakes	2½ tsp
9 tbsp (30g)	Instant Hot Oat Cereal	0 tsp
QUICK MEALS AND EXTRAS		
1 small can (220g)	Baked Beans	2½ tsp
½ can (213g)	Minestrone Soup	¾ tsp
½ can (213g)	Meatballs in Onion & Gravy	¼ tsp
½ can (85g)	Processed Peas	¼ tsp
1 tbsp (15g)	Tomato Ketchup	¾ tsp
2 tbsp (30g)	Chutney	3½ tsp
BAKED GOODS & DESSERTS		
1 small bowl (100g)	Jelly (made-up)	3½ tsp
½ can (140g)	Strawberries in Syrup	5½ tsp
1 pie (50g)	Small Individual Fruit Pie	4½ tsp
1 slice (30g)	Jam/Buttercream Swiss Roll	2½ tsp
2 scoops (75g)	Vanilla Ice-cream	3 tsp
2 biscuits (15g)	Semi-sweet Biscuits	1 tsp
1 pot (150g)	Fruit Flavoured Yoghurt	4 tsp
1 pot (150g)	Natural Yoghurt	0 tsp
DRINKS		
1 can (330ml)	Cola	7 tsp
1 glass (½ pint)	Blackcurrant (diluted)	5 tsp
1 glass (½ pint)	Orange Squash (diluted)	2½ tsp
1 pint	Beer	2½ tsp

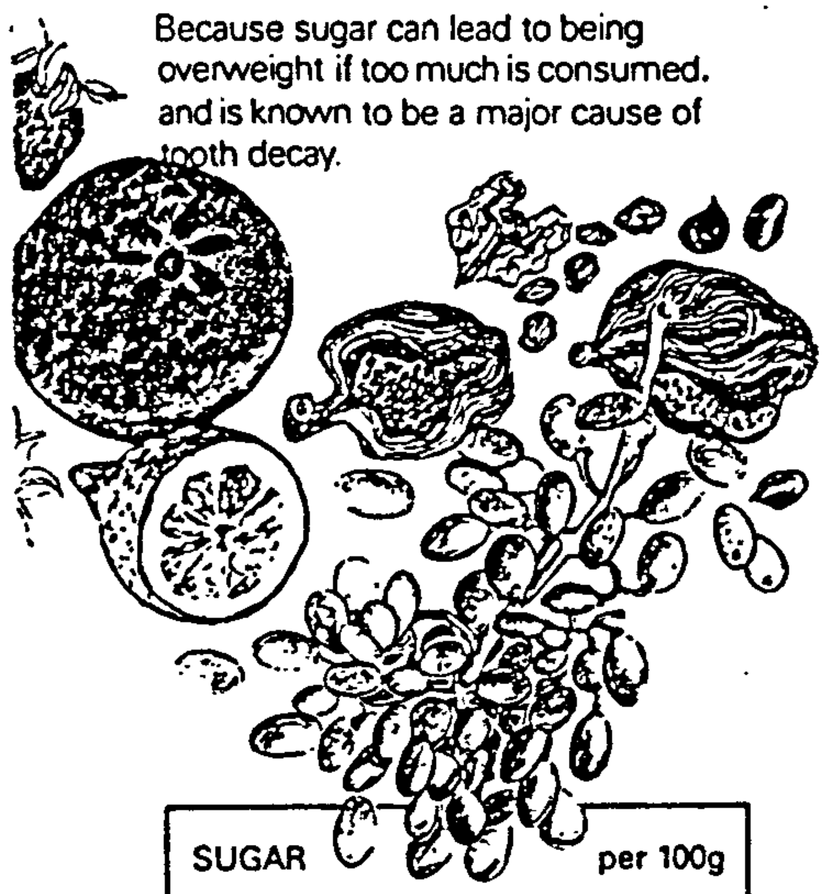
Figure 3.11 Morrisons "Healthy Eating" advice on sugar

SUGAR

WE ARE RECOMMENDED TO EAT LESS SUGAR

WHY?

Because sugar can lead to being overweight if too much is consumed, and is known to be a major cause of tooth decay.



SUGAR	per 100g
Chocolate biscuits	43.4g
Custard cream	30.2g
Jam tart	37.5g
Ice cream	22.6g
Boiled sweets	86.9g
Milk Chocolate	56.5g
Orange Drink	28.5g
Tomato Ketchup	22.9g
Drinking Chocolate	73.8g
Sponge cake	30.3g

WHAT IS SUGAR?

Sugar is essentially a sweetener. Most common to us in its white granulated form, it actually comes in many forms and under many names – Sucrose, Fructose, Maltose, Dextrose, Lactose, Glucose, Glucose Syrup, Sugar Syrup, Molasses, Raw Cane Sugar, Muscovado Sugar.

HOW MUCH SUGAR SHOULD WE EAT?

No more than 50g (2oz) per day is recommended and it would be even better to consume less than that if possible.

WHICH FOODS CONTAIN SUGAR?

Sugar is found mostly in sweet foods: confectionery, cakes, biscuits and soft drinks. It is also present in some savoury foods such as sauces and pickles. Look at the ingredients panels on foods for the sugar names listed above.

The table illustrates the level of sugar in certain regularly consumed products.

LOOK FOR MORRISONS L E S S / S U G A R *SYMBOL*

L E S S

S U G A R

are promoted by their manufacturers (see examples in Chapter One). However, the sugar industry has reacted in three ways over the past few years to defend sugar as "an important part of a balanced diet".

Firstly, it has stepped up its promotional activities to the consumer and the trade; secondly, it has further segmented the sugar market, creating the image of a healthy 'unrefined cane sugar'; and thirdly, it has attempted to put across a more prominent public relations image and increase communication to a mass audience about scientific and academic work relating to sugar and health.

In May 1984, British Sugar PLC launched the biggest ever advertising and promotions campaign by a sugar processor that embraced all these three areas. The company announced it was investing £2 million, including in this sum a £1 million multi-media advertising campaign, spread over 12 months. The aim of the whole campaign was to give sugar its proper recognition in the retail market, in particular its Silver Spoon brands.

The central theme was that: "Sugar is fundamental to our taste and enjoyment besides being an essential ingredient in a healthy and active life" (Supplement to "The Grocer" May 1984). The media campaign was centred on double-page spreads in women's magazines.

British Sugar's speciality sugars - that is, castor, icing, demerara, light golden soft, rich dark soft, preserving, cube and coffee crystals - were given particular prominence in the promotion. A significant part of the media investment was to "re-educate" British housewives to "appreciate the usefulness of speciality sugars". The advertising campaign was planned to reach 80% of housewives who would each see the advertising at least 10 times.

Other parts of the campaign included on-pack cooking promotions, the establishment of a Silver Spoon Centre Kitchen as a new recipe service to cookery writers, the Silver Spoon Schools Advisory Service aimed at supplying

educational material to home economics students, a general schools pack for primary and middle schools (this included a 20 minute film, videos, filmstrips, wallcharts and booklets). Through the Sugar Bureau there was sponsorship of selected women's sports and, through the Royal Geographical Society, sponsorship of a number of research expeditions. Packaging and the Silver Spoon Logo were also redesigned.

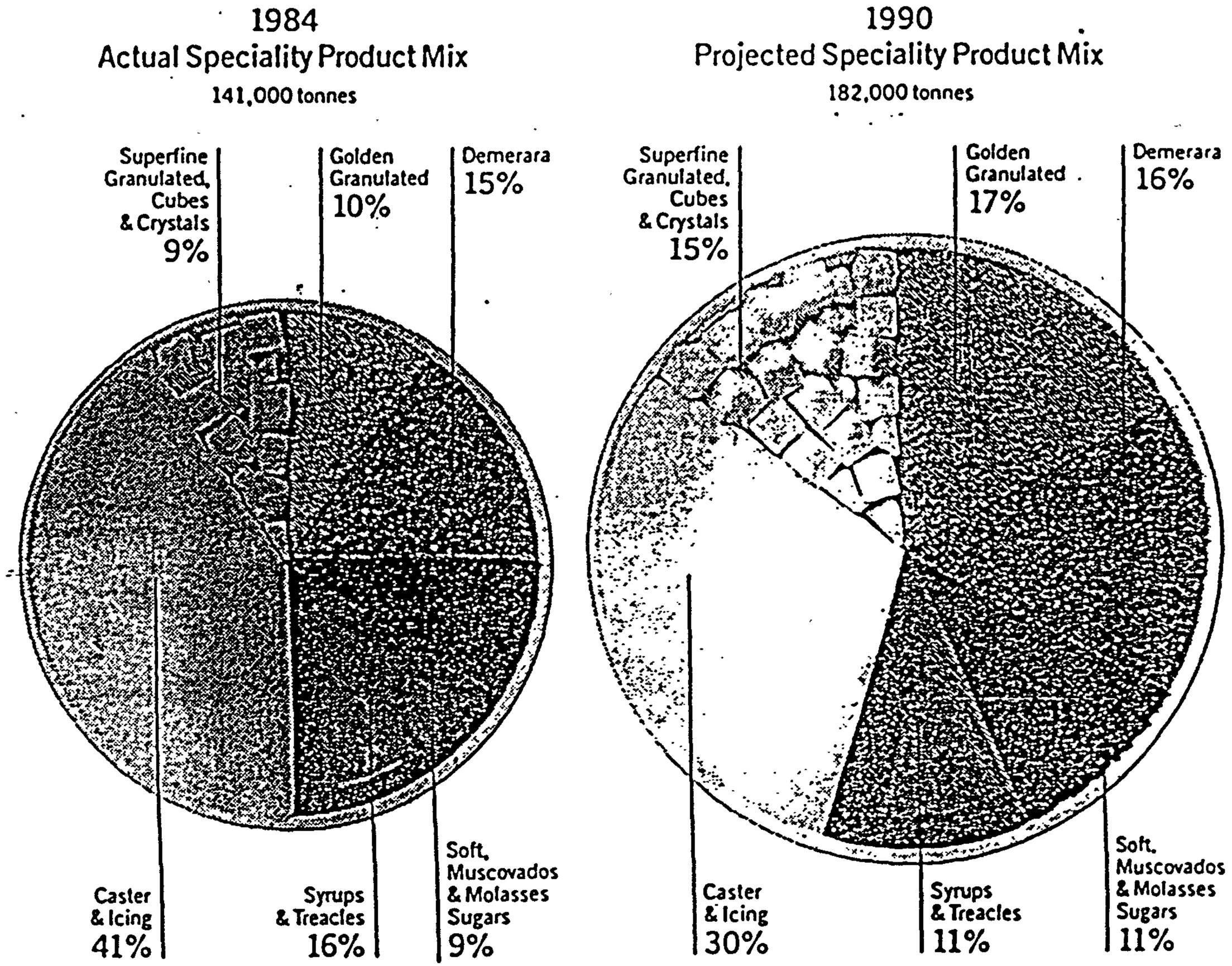
The main objective of British Sugar's promotion was to capture a larger share of the speciality sugars market. While consumption of white granulated packet sugar has declined, the share of the retail sector covered by speciality sugars has gone up from around 11% to 18%. Figure 3.12 shows the speciality sugars product mix. This is expected to increase by 29% between 1984 and 1990, with "Golden Granulated" in particular rising by more than two-thirds.

One of the attractions of speciality sugars is that they offer distributors higher profit margins. "White" specials give distributors profit margins between 10 and 20% while the newer "natural" products can offer as much as 25%. Ordinary white granulated packet sugar only has a profit margin of around 3% and supermarkets often use it as a loss leader.

The growth on sales of "natural" sugars has been an ironic result of the 'healthy eating' boom. The concept of the "unrefined cane symbol" was pioneered by the sugar merchant Edward Billington Ltd in 1982 when they launched their brand "Golden Granulated". A survey commissioned by Billington's showed that over 50% of its Golden Granulated purchasers bought the brand because it is unrefined and perceived to be "healthier" (Marketing, August 9, 1984). In short, Billington's successfully segmented the sugar market.

"Unrefined" sugar can only come from sugar cane. Brown sugar from sugar beet is coloured in some way, usually by adding molasses or caramel. For cane sugar to be 'unrefined' it is cleaned and processed at source, that is,

Figure 3.12 Speciality Sugars Product Mix



Source: "The Grocer", November 30, 1985

the country of origin. This requires the installation of processing and cleaning facilities in the producer country. The various products from this process are then bagged and shipped to importing countries in containers ready for rebagging in consumer size units. Billington's 'unrefined' sugars got a further boost when Professor John Yudkin, long-term critic of white sugar, published some research findings that were favourable to 'unrefined' sugars (see Eisa and Yudkin, 1985).

Promoting sugar as part of a balanced diet has been an area of particular concern for the sugar industry and one in which they have been consistently active. In Tate and Lyle's 1984 Annual Report, the then Chairman, Robert Haslam, wrote:

> "Sugars and syrups are a key part of our diet ... biased attitudes on sugars, based on unsubstantiated accusations of damage to health have continued without abatement during the last year (1983). When a debate becomes as strident and ill-informed as this one, it is difficult for the consumer to maintain a balanced view. We have now decided that we should set the record straight and we propose to launch an information campaign on the issue during the coming year." (p.4)

Market research carried out by British Sugar showed that the consumer regarded white sugar as a processed product rather than as "natural". This was the rationale behind the company's 1987 media campaign promoting their Silver Spoon brands. British Sugar spent £1.25 million on the campaign which ran through June mainly in women's magazines. The theme of the advertisements was to portray sugar in its natural setting. An example of this ("News of the World" Sun Day magazine, June 7, 1987) was a picture of a young, fresh sugar beet with the headline: "Sugar Beet. All we've done is made it easier to cook with". The copy, illustrated with examples of Silver Spoon's speciality sugars and suggested uses, said:

> "Silver Spoon sugars are just as natural as the humble sugar beet

they're made from. All we do is take the sugar out of the beet to make it easier for you to use. None of the goodness is taken out. So you can be confident of using natural ingredients in your recipes when you cook with our sugars. Silver Spoon sugars and syrups lend themselves to all manner of recipes, from old favourites to the wierd and wonderful. Here are a few ideas. All you need to use is Silver Spoon and a little of your imagination."

3.6.5.1 Public Relations Activities

The industry-funded Sugar Bureau has been instrumental in putting sugar's public image across. It has produced a pack called "Putting Sugar into Perspective" aimed at answering some of the health questions levelled at sugar. Partly because of its popular appeal, sugar has been a topic consistently in the media. However, subjects on health and diet are often difficult to communicate to all levels of society and sugar has proved no exception. An example of an attempt by the industry to put over the scientific message on sugar and health is illustrated in the work of the World Sugar Research Organisations (WSRO).

The WSRO has played a pivitol role in co-ordinating, collecting and communicating the latest research on sugars and health. The London-based WSRO is funded by the sugar industry from around the world and helps fund research projects that relate to sucrose consumption. Between 1978 and 1983 the WSRO was supporting 77 research projects in Australia, Canada, Europe, South Africa, Argentina and the United States of America.

The WSRO sees its role becoming increasingly important:

"... as a means of counteracting misleading information from self-styled, unqualified 'nutrition experts' who manage to attract the headlines in the press, on the radio and on television. The industry's responses have to be based on sound scientific experiments, conducted objectively, published in refereed scientific journals and capable of being scrutinized, repeated and confirmed, before being accepted as 'scientific fact' ". (WSRO Special Bulletin, NO. 1, October 1983)

One speaker at a recent WSRO scientific conference (Schiweck, 1985) saw the problem of consumers becoming confused or receiving incorrect information about sugar as a result of the flow of information in the area of nutrition. Schematically, he saw the flow of information as illustrated in Figure 3.13.

At times information from Level 5 goes straight to Level 2 where the results are often interpreted non-critically or wrongly. The relevant background knowledge for a correct assessment is often lacking so information reaches the consumer at Level 1 in the form of sensational headlines or incorrect or misleading information. The sugar industry, as it sees it, has tried to redress this imbalance.

It also has a long history of successfully lobbying and promoting its cause. The sugar industry will continue to promote and support sugar. These activities will not only influence consumption but also the extent to which supplies are made available for consumption.

3.7 Sugar Consumption in the U.K.: Summary

Sugar consumption rose substantially in the U.K., doubling and then redoubling in the past 100-150 years, but has now plateaued. Sugar has established a place as a major food in the U.K., not only in its table-top form, but more and more as an important ingredient in hundreds of food and drink products. Since 1973, U.K. sugar production has been controlled by the European Community's Sugar Regime, as part of the Common Agricultural Policy. This has resulted in a major shift towards sugar supplies derived from home-grown sugar beet, processed by British Sugar, which now accounts for half the total sugar market, the rest being supplied by third country sugar cane imports refined in the U.K. by Tate and Lyle. The main emphasis of the EC Sugar Regime is production, which has to a certain extent become divorced

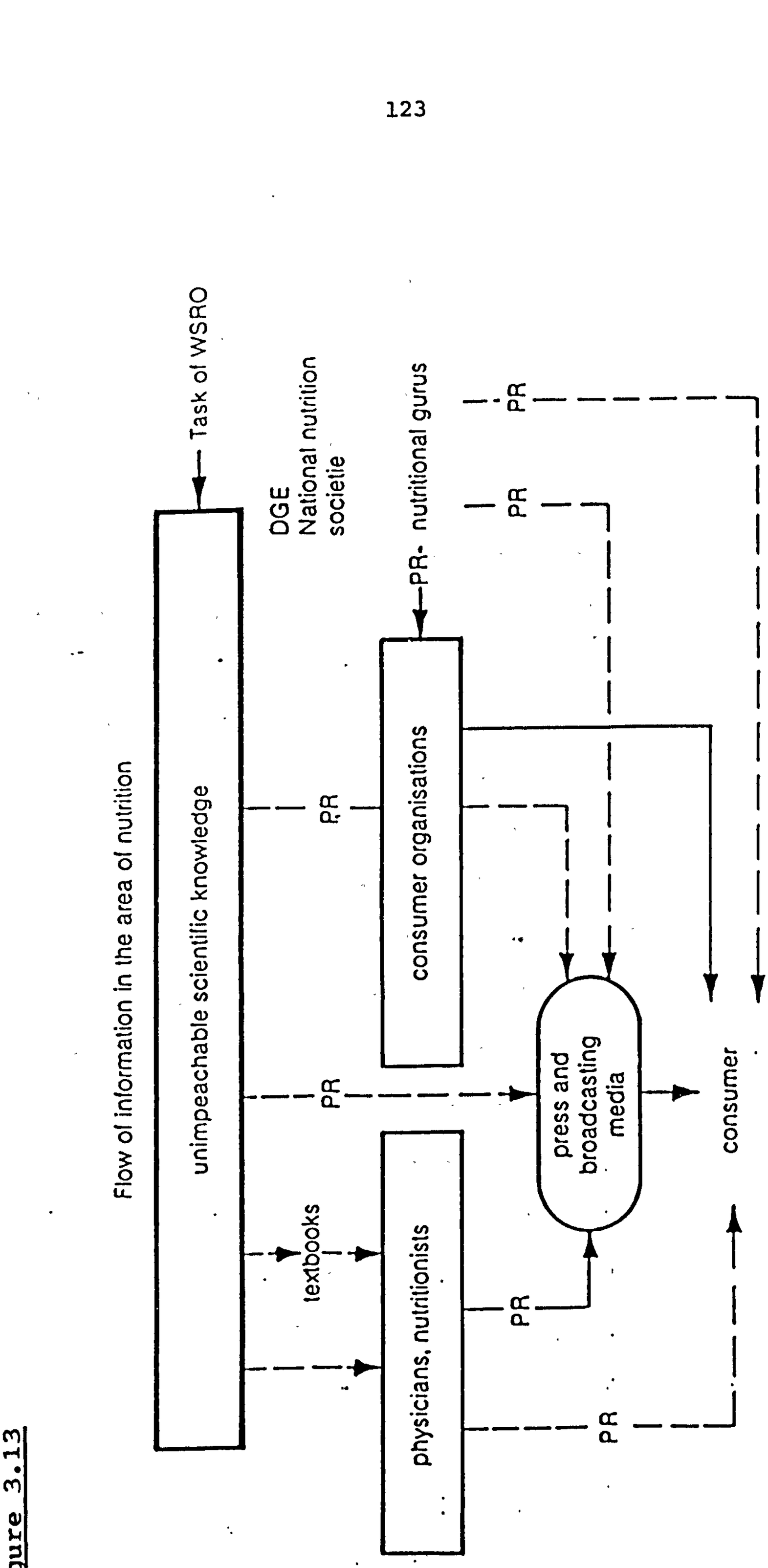


Figure 3.13

Source: Schweck, 1985

from demand and trends in consumption.

In 1986/87 there was approximately 2,621,000 tonnes of sugar available in the U.K. for domestic consumption whilst domestic consumption actually equalled only 2,285,000 tonnes (see Table 3.7). Of this, 69% went for industrial use and the rest to the retail or table-top market. The principal uses of sugar in the U.K. industrial market are to manufacture soft drinks, chocolate and sugar confectionery, baked goods, biscuits and breakfast cereals which together amount for more than 60% of industrial sugar purchases. A small number of companies account for sugar purchases, 15 accounting for nearly half and 45 for more than two-thirds of the industrial market for sugar.

Data from the National Food Survey (NFS) clearly shows a massive decline in the retail market for sugar. Household sugar consumption has more than halved between 1966 and 1986, and stood at 11.85kg/person/head in 1986.

Consumption Level Estimates, or disappearance data, again show a decline in total sugar supplies entering the food chain, although for the 1980's this figure has remained virtually constant at around 37 kg/person/year.

However, while average "consumption" has been static, the striking feature of individual dietary survey's, bearing in mind the difficulty in comparability, is that there is considerable variation in consumption habits. Some individuals consume more sugar by several orders of magnitude when compared to other individuals. On average women eat less sugar than men, but for each sex sugar contributes roughly the same amount of energy (as a percentage) when compared to total dietary energy intakes.

Rugg-Gunn et al. (1986b) have shown that, among adolescents, high sugar consumers do not eat different foods from low sugar consumers, but a greater quantity of the sugar containing foods. The main sources of added sugar were table sugar, confectionery and soft drinks which fits in neatly with the industrial purchases of sugar. Sugar as an ingredient in food products such as

baked beans, was a relatively unimportant source of sucrose.

It is clear that sugar sales have been hardest hit in the home and on the table-top. The NFS data shows that this decline has been across all income groups, but is greater the higher the income. The decline in the use of sugar is reflected in the general negative attitudes shown by consumers to sugar. This has been reinforced by dietary guidelines advocating a reduction in sugar eating. Consumers see sugar as a processed "unnatural" product. Consumer attitudes to table-top sugar beg the question: will their negative buying habits be reflected by the same behaviour towards sugar in manufactured foods? For example, 86.6% of respondents (n=576) agreed with the statement: "there is too much sugar used in food manufacturing" in a consumer survey carried out by Food Policy Research. More than 90% also agreed "children should eat less foods containing sugar".

Recent years have seen a continued spate of negative-sugar activity in many areas. The media, in all its forms, has advised people how to reduce sugar intakes, local authorities have devised and implemented food policies including reducing sugar intakes and, in many instances, major food retailers have pointed out to their customers that it is advisable for them to be careful when it comes to sugar consumption.

The sugar industry itself has not stood still while all this has been happening and has defended the role of sugar in the diet. There has been a substantial and sustained public relations campaign aimed at putting the evidence about sugar before opinion-makers, the research and scientific community and the general public. Also British Sugar is reported to have spent around £3.25m, since 1984, supporting the retail market by promoting its Silver Spoon brands.

The question remains, however, looking at the overall picture regarding sugar consumption, "will the long-term decline continue?". Between 1976/77

and 1986/87 per capita consumption of sugar has fallen some 10%. The largest decrease has been in the retail market (down 5.25 kg/person/year), but this fall has been compensated a little by increased industrial use (up 1.5 kg/person/year). But there has still been a net market reduction of around 180,000 tonnes of sugar. When compared to the late 1950's, when sugar consumption peaked and averaged around 50 kg/person/year (compared to 37 kg/person/year in the 1980's) this represents a drop of 25% or some 700,000 tonnes of sugar in 30 years.

CHAPTER FOUR

SUGARS AND SWEETENERS IN USE IN THE U.K. AND THEIR APPLICATIONS IN FOOD AND DRINK MANUFACTURE

4.1 Introduction

The purpose of this chapter is to examine and analyse the current sugars and sweeteners market in the U.K. The role of sugars and sweeteners as used in food processing will be studied, emphasising the relationship between sucrose and other sweeteners and possible changes in sucrose consumption of real or potential importance. In doing this the total sugar and sweeteners market will be considered. When sugar is usually discussed people often just mean sucrose, but there are now a whole range of sugars and sweeteners from which a food manufacturer can choose. In fact, over the past two decades, there has been a number of significant developments in the world sugar and sweetener market. This is especially since the mid 1970's with the increasing competitiveness of High Fructose Corn Syrups (see later) and, more recently, the widespread regulatory approval of a range of new artificial sweeteners.

While the U.K. retail market for sucrose has been in marked and dramatic decline, the total market for sucrose has remained remarkedly steady between 1976 and 1986, hovering between 2.4 and 2.25 million tonnes white sugar equivalent. There was a high of 44.2 kilograms/per person/per year and a low of 38.9 kg during this period - see Chapter Three for more information. However, within the total sweetener market there have been a number of significant changes, mainly reflected in the industrial market, but also in the retail sector.

Perhaps the year of 'change' for the British sucrose producers was 1983 with two important events of direct relevance. Firstly, there was the publication of the NACNE report and the subsequent increased attention to

sugar intakes and "healthy eating". Secondly, the U.K. expanded the principal of the multiple sweetener concept, that is, having available for use a wide range of different sweeteners. On September 6, 1983, the "United Kingdom Sweeteners in Food Regulations" (No. 1211, HMSO, 1983) permitted five bulk sweeteners and four high intensity sweeteners (Table 4.1) for use in beverages, food and table-top applications. This approval followed a five-and-a-half year review (which also included some artificial sweeteners already in use, for example, saccharin) by the Food Additives and Contaminants Committee and the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (MAFF, 1982).

TABLE 4.1

PERMITTED SWEETENERS IN THE UNITED KINGDOM

Bulk Sweeteners	High Intensity Sweeteners
hydrogenated glucose syrups	acesulfame potassium
isomalt	aspartame
mannitol	saccharin (and its sodium and calcium salts)
sorbitol	thaumatin
xylitol	

The legal application of these sweeteners to food and drink is subject to certain restrictions; for example, they are not permitted in foods manufactured specifically for babies and young children.

Sugars, such as sucrose, are often referred to as "nutritive" sweeteners and high-intensity or low-calorie sweeteners as "non-nutritive" sweeteners. The United States Food and Drug Administration distinguishes between the two by defining non-nutritive sweeteners as:

> "substances having less than 2 per cent of the caloric value of sucrose per equivalent unit of sweetening capacity." (U.S. Code of Federal Regulations, 1979)

This definition has been adopted in this Chapter.

The following sections concentrate on the industrial use of these new sweeteners since 1983 as well as other sugars used in U.K. food and drink manufacturing. Finally, these are discussed in the context of the implications and outlook for sucrose.

4.1.2 Background: The use of sucrose in food and drink manufacturing

Due to its wide ranging properties and long availability in the industrial food chain, sugar has become an extremely versatile and useful food and ingredient. As such the production and distribution of sucrose and the resulting manufacturers that use it have grown to become extremely important sectors of British industry.

Sucrose has a unique range of properties that have made its use ideal for an extensive and diverse range of food products. In many of these instances sucrose is used in the food or drink product for a combination of its properties. Other important reasons for its use by manufacturers is its degree of purity; the fact that if it is produced to a consistently high quality and uniform standard and reacts predictably in food manufacturing systems.

The literature on sucrose and other sugars is extensive, reflecting the massive amount of research and development that has gone into the use of sugar in foods (Pancoast, 1980). The primary purpose for using sucrose in food products is as a sweetener. The sense of sweetness in a food product is the subjective evaluation of the interaction of sugars, total acidity, pH level and the other constituents of a food (Wursch and Daget, 1987; Frijters, 1987). In general, as the concentration of sucrose (or any other sweetener) is increased so will the sense of sweetness, up to a limit. At higher concentrations an unpleasantness develops (Moskowitz, 1971). Relative sweetness, that is, the comparison of sweetness between sweeteners, is also dependent upon

temperature, concentration and acidity (Nicol, 1982).

Another vital use of sucrose is to control water activity and humidity in food products. This is of considerable importance to many types of food products which are exposed to fluctuating humidity conditions when in storage or the marketing channels. Below is a list of the major functional properties of sucrose (adapted from Pancoast, 1980):

a) Preservative effect - sucrose solutions of high density act as a preservative against most microorganisms.

b) Fermentable carbohydrate - sucrose is widely used as a fermentable carbohydrate as, for example, in bread baking.

c) Flavour enhancement - sucrose will serve as an agent for the enhancement of flavour when used in concentration in which the sense of sweetness will not override the flavours which are being accentuated.

d) Bulking agent - sucrose serves as a bulking agent in a variety of formulated foods, for example, in dry mixes of various types. It also serves, along with other ingredients, to give bulk to many confectionery products.

e) Body and Mouth feel - the "body" or "mouth feel" of beverages may be altered with the use of sucrose by reducing the watery condition of the product.

Below, the functional properties of sucrose are discussed in relation to a selection of food product categories:

1. Soft drinks

Sugar in soft drinks is used principally for its sweetening power. It also provides texture and "mouthfeel" although this is not a central reason for its use.

2. Baked products

In cake making sugar is particularly important for the development of structure. It raises the temperature at which the egg coagulates and delays the gelatinisation of the starch. In so doing it allows the mixture to rise fully before it is fixed thermally, sugar is also effective in delaying the rate at which the cake goes stale by being resistant to changes in moisture levels.

In biscuit making the presence of sugar is important to structure. During the cooking of the biscuit dough, as the temperature rises the sugar dissolves only to re-crystallise on cooling thereby giving biscuits their characteristic crunchy texture.

3. Chocolate

Chocolate is a suspension of sugar crystals (usually sucrose) and ground cocoa solids in cocoa butter. Sugar contributes to sweetness (which counteracts the natural bitterness of the cocoa) and texture. The textual properties are a consequence of sugar being present in the solid phase in chocolate, although the crystals are ground so finely they are imperceptible to the tongue. This is responsible for the characteristic 'snap' of chocolate.

4. Sugar confectionery

Sucrose provides bulk to sugar confectionery and functionally contributes to the 'sugar glass' produced in certain of these products.

5. Dairy products/Frozen desserts

Ice cream is the major use of sugar by the dairy industry. Sugar improves texture and has an influence on the freezing point of the formulation. In frozen confectionery sugar is mainly present for sweetness followed by texture.

6. Desserts

The major reason for using sugars in desserts is sweetness. It also contributes textural properties to products, such as whipped desserts and custards and has preservative function in products such as pie fillings through its ability to lower available water levels.

7. Preserves (including jams and jellies)

The high osmotic pressure exerted by sugar solutions is a major factor in suppressing microbiological spoilage in the storage of foods. Jams, normally, contain about 70% dissolved sugars.

8. Canned foods

Sugar is not required to be added to canned fruit for preservative purposes, but it enhances and conserves the natural flavour and assists in the retention of texture during processing.

9. Pickles and sauces

Sugar is used for its sweetening property which acts as a balance to the natural acidity of these products.

Table 4.2 summarises the role of sucrose in the food categories that represent its principal industrial use. Sugar is the traditional major sweetener used in food manufacturing. Its use encompasses a diverse range of food categories and hence many hundreds of food products. Clearly, the use of sugar in food and drink is not solely as a result of its sweetening value, but often for a combination of its many functional properties. To meet the requirements of food and drink manufacture, sucrose is produced in different forms. These are different types of granulated sugar, where particle size is

TABLE 4.2

TECHNICAL REASONS FOR USING SUCROSE IN FOOD-MARKET SECTORS

Market sector	Technical reasons for using sucrose					
	Sweetness	Bulk	Texture	Humectancy	Freezing point depression	Osmotic effects
Soft drinks	*					
Baked products	*	*	*	*		
Sugar confectionery	*	*	*			
Chocolate confectionery	*	*	*			
Dairy/frozen	*	*	*		*	
Desserts	*	*				
Preserves/spreads	*	*				*
Canned goods	*					*
Pickles/sauces	*					

Source: Lindley, 1983

varied depending on its food application, or as liquid sugar when water may be added to the final product. Sucrose is also produced in a range of speciality sugars, such as brown or soft sugars which are primarily used for the flavour and colour they add to many foods.

Finally, sucrose imparts a number of sensory characteristics to food and drink. Lindley (1988), described these as "intrinsic" and "incidental" (Table 4.3):

TABLE 4.3

SENSORY CHARACTERISTICS OF SUCROSE

A. Intrinsic	B. Incidental
Sweetness	Palatability
Flavour	Acceptability
Texture	
Appearance	

4.2 Glucose Syrups and Isoglucose

4.2.1 Introduction

A significant impact on the world sweeteners market over the past quarter of a century has been the increasing competitiveness and use of sugars manufactured from starch, that is, the important constituent of all plants and a major form in which carbohydrates are stored. In particular High Fructose Corn Syrups (see later) have had a devastating effect on the U.S.A. sucrose market with the latter now less than 50% of the total U.S. sweetener market (F.O. Licht, 1987). The main area for the substitution of sucrose by High Fructose Corn Syrups (HFCS) has been in soft drinks manufacture. HFCS are also taking increasing shares of other markets such as in Japan, but in Europe production is controlled by a series of production quotas within the European

Community Sugar Regime.

The most commonly used sugars after sucrose in U.K. food manufacturing are glucose syrups and, to a much lesser extent isoglucose (as HFCS are known as in Europe). Later sections will explain in more detail what glucose syrups and isoglucose are and where they are used in food manufacture.

4.2.2 The historical development of glucose and isoglucose

The development of sweeteners manufactured from starch can be traced back to the early nineteenth century when the Russian chemist Kirchoff discovered in 1811 that starch yielded a sweet substance when heated with acid. In 1815 de Saussure identified acid hydrolysis as the reaction behind Kirchoff's observations and that the end product of hydrolytic reaction was glucose. This discovery is the foundation of today's corn wet milling industry responsible for producing syrups and sugars from starch (Coker and Venkatasubramanian, 1987).

However, at this time the commercial and technological advances in sweetener production from starch were limited. In 1935 there was still only one type of starch sweetener a 42DE acid converted glucose syrup (see later for definition). The first major technological breakthrough since Kirchoff was when Langlois and Dale patented the use of commercially available enzymes to hydrolyise starch in 1940. This new technique was not used to produce large quantities of glucose syrup until the 1950's.

The discovery, isolation and application of enzymes helped in the development of many different specifications of glucose syrup, each with its own properties. In this area it was the commercial development of glucose isomerase, which converts glucose to its sweeter isomer fructose, which secured the present day development of the glucose sweetener industry. The use of enzymes to transform glucose to fructose to produce isoglucose (HFCS)

was first put into production in 1967. By 1972 isoglucose was being produced by a continuous process, rather than by batch production, which meant large reductions in production costs. This made isoglucose, a direct replacement for sucrose in many applications, very price competitive with sucrose especially in the soft drinks markets. Table 4.4 gives a breakdown of the distribution by market for isoglucose (HFCS) in the U.S.A.:

TABLE 4.4

THE PRINCIPAL MARKETS FOR HFCS IN THE U.S.A.

	%
Beverages	67.5
Processed Food	14.1
Baking	10.2
Ice Cream	4.4
Confectionery	0.5
Miscellaneous	3.3

Source: Bujake, 1986

4.2.3 The Manufacture of Glucose Syrups and Isoglucose

Starch and its derivatives have many applications. Not only in the food and drink industry, but also in the manufacture of certain papers and board, chemicals, pharmaceuticals, textiles, adhesives and a number of other areas including the growing biotechnology industry. Glucose syrups are the names given to nutritive carbohydrates prepared by the hydrolysis of starch, in the main derived from maize (corn). The products are differentiated either by the kind and degree of hydrolysis or by the processing they receive following hydrolysis. Put simply, unlike sucrose refining which produces one basic product - sucrose, processing starch to produce glucose syrups can result in dozens of product types with different sugar 'mixes' and characteristics. For example, one U.K. manufacturer produces six basic glucose syrups although

the total number of products amounts to 120 tailored to the specifications of end-users (Tunnel Refineries, 1986).

The three principal steps used in the manufacture of glucose syrups once the starch has been isolated and the debris removed - the wet milling process - are:

1. Hydrolysis - starch hydrolysis is catalysed by both acids and enzymes
2. Refining - this is the process of removing unwanted impurities by filtration, carbon absorption, ion exchange
3. Concentration - achieved by evaporation or by roll or spray drying. In the case of dextrose it is achieved by crystallization

In the manufacture of isoglucose (HFCS) there are two additional processing steps:

4. Isomerization - an enzymatic process by which dextrose is converted to fructose
5. Enrichment - a separation process that create syrups with a very high fructose content

By varying the stages of the milling and refining process the extensive range of glucose syrups and isoglucose is manufactured.

The mixtures resulting from hydrolysis contain varying amounts of reducing sugars, such as dextrose and other saccharides. In other words, for each method used to produce a particular glucose syrup the product has a well established mono-, di- and higher saccharide composition at the given degree of hydrolysis. Hence, especially using enzyme technology, a large number of glucose products can be produced. The many types of glucose syrup are identified by reference to the "Dextrose Equivalent" (DE) value. This is defined as the total reducing sugars in a glucose syrup, analytically determined

by copper reduction methods and compared to the reducing power of dextrose. This theoretical laboratory method gives the Dextrose Equivalent value of a glucose syrup and it varies directly with the extent of hydrolysis. The DE value does not, therefore, mean the dextrose content of a glucose syrup, for example, pure maltose has a DE of 57 and pure fructose has a DE of 96. Neither of these saccharides, by definition, contain any dextrose, however both are capable of reducing copper and their reducing power is compared to that of dextrose to calculate the DE (Horn, 1981).

Different types of glucose syrup can therefore be tailor-made for particular food applications. For example, among regular glucose syrups 35, 42, and 55 DE glucose syrups are generally used in sugar confectionery depending on the functional properties required. Table 4.5 shows some examples of the food applications for starch, derived glucose syrups and dextrose:

TABLE 4.5

FOOD APPLICATIONS FOR STARCH, DERIVED GLUCOSE SYRUPS AND DEXTROSE

	FOOD CATEGORIES
Starches	flour confectionery yogurts salad dressings dry mixes
Regular and high maltose 42 DE syrups	high boilings sweets toffees caramel gums composite bars baby foods
Dextrose/maltose 63 DE syrups	jams jellies marshmellows chocolate centres brewing
High dextrose syrups 95 DE	brewing/cider wine citric acid caramel colour
Dextrose monohydrate	chewing gum sorbitol Vitamin C breakfast mixes
High fructose/glucose syrups	soft drinks jams beer and cider
Maltodextrins	for spray drying flavour carriers coffee whiteners baby foods

Source: Tunnel Refineries, 1986

The main functional properties of glucose syrups are:

- vicosity (bodying agent)
- hygroscopicity (humectancy)
- flavour enhancement
- crystal inhibition (size control)
- sweetness
- osmotic pressure (preserving action)
- protective colloid (foam stabiliser)
- adhesiveness (binding action)
- solubility (emulsification, plasticity)
- appearance (gloss, lustre or clarity)

Table 4.6 shows examples of the relative sweetness of glucose syrups:

TABLE 4.6

RELATIVE SWEETNESS OF GLUCOSE SYRUPS AND HFCS

	Sweetness Factor
Sucrose, crystalline	1
Glucose, liquid solids	0.7
Fructose	1.5-1.7
HFCS-42 (1)*	1
HFCS-55	1-1.1
HFCS-90	1.2-1.6

Source: McGinnis and Muller, 1984 and Nicol, 1982

*(1) Since HFCS are derived from glucose syrups, classification according to DE becomes meaningless. These syrups are therefore classified separately according to fructose content.

4.2.4 Glucose syrups in U.K. food and drink manufacturing

Starch is regulated in the EC by the Starch Regime, maize being the most important source of starch accounting for three-quarters of Community use in 1983/84 (House of Lords, 1985). During the 1980's the use of starch obtained from wheat has become more widely used, partly due to the buoyant market for gluten. The EC uses wheat gluten to add to Community produced soft wheat thus reducing third country imports of hard wheat. The wheat gluten is added to soft wheat to produce the high protein grists required to manufacture the types of bread popular in the U.K. In the past bread was

manufactured using a large proportion of high protein hard wheats from North America. Glucose, therefore, is manufactured from the remaining wheat starch as a by-product of the gluten industry.

In 1983/84 the British starch industry delivered 800,000 tonnes of starch of which 200,000 tonnes was derived from wheat. Around 70% of total usage of starch and starch derivatives (such as glucose syrups) was used by the food and drink industries (see Table 4.7 below), the rest went to the paper, board, chemical and other industries.

One of the major uses of starch in the food sector is in the form of one of its derivatives, namely glucose syrups. Glucose syrups in many applications are in direct competition to sucrose and it is estimated that between 1963 and 1978 some 230,000 tonnes of sucrose consumption was displaced by glucose, with most of the substitution occurring before 1973 (Harris, 1985). The food usage of starch and starch derived products comes to some 500,000 tonnes and the total starch and starch product usage is broken down as follows (Table 4.7):

TABLE 4.7

TOTAL U.K. STARCH AND STARCH PRODUCT USAGE

FOOD CATEGORY	% OF TOTAL
Confectionery	24
Brewing and cider	13
Custard powder, gravy powders and soups	11
Soft drinks	8
Jams, preserves, meat and vegetable canning	8
Bakery products	4
Miscellaneous	2
	70

Source: House of Lords, 1985

The proportion of starch used in various food categories varies considerably depending on which product is being manufactured. The product with the highest starch content, for example, is custard powder at 95% while other products like pickles, sauces and soups use a very low percentage, anything from 1-5%.

As mentioned above the principal use of starch is in the manufacture of glucose syrups; Table 4.8 gives the U.K. production of glucose syrups between 1976 and 1986, this has remained consistently stable at around 350,000 tonnes. There are three main starch and glucose syrup producers in the U.K., these are:

CPC (U.K.) Ltd (taken over by Ferruzzi in 1987)

Tunnel Refineries Ltd (30% owned by Tate and Lyle)

Cagill U.K. Ltd (owned by the U.S. company Cagill)

In conclusion, glucose syrups are widely used in the U.K. food industry, especially in the confectionery industry, for example, in 1982, 350,000 tonnes of sucrose was bought for use in sugar and chocolate confectionery, 5,850 tonnes of syrups and treacles and 143,390 tonnes of glucose syrups (BCCCA, 1987).

4.2.5 Isoglucose used in British food and drink manufacturing

In the EC isoglucose is defined as the product obtained from glucose or its polymers with a content by weight in the dry state of at least 10% fructose (MAFF, 1986). Isoglucose is a straight replacement for sucrose for a number of applications and as such is included in the EC Sugar Regime. The EC Sugar Regime covers white and raw sugars, syrups, sugar beet, sugar cane, molasses and caramel containing more than 50% sucrose. Isoglucose was subject to a

TABLE 4.8

U.K. PRODUCTION OF GLUCOSE SYRUPS (1976-1986)

	'000 tonnes
1976	379,361
1977	385,221
1978	407,611
1979	362,988
1980	347,476
1981	340,515
1982	365,386
1983	365,555
1984	382,071
1985	372,952
1986	387,976

Source: MAFF, 1987

different regime between 1977 and 1981, but since July 1981 has been included as part of the Sugar Regime. The definition of isoglucose under the Sugar Regime is important. It was extended in February 1984 for the purposes of the production quota arrangements so preventing isoglucose manufacturers producing high concentration syrups which would have effectively evaded the Sugar Regime production quotas.

The present production quotas and price mechanisms of the EC Sugar Regime, as they apply to isoglucose effectively means that production of isoglucose is restricted. Thereby, a potential competitor to sucrose is virtually eliminated from the market. It is argued that since the EC is already in surplus supply regarding sucrose, it would be uneconomic to support a one-for-one replacement. The U.K. 'A' and 'B' quota for isoglucose is 27,483 tonnes, dry matter (Agra-Europe, 1986). Table 4.9 gives the U.K. consumption of isoglucose. It can be seen that from negligible supplies in the 1970's isoglucose had started to gain an increasing niche in the sweetener market, with nearly a third of supplies coming from EC imports. The only large producer of isoglucose in the U.K. is Tunnel Refineries Ltd. The main food applications for isoglucose are bakery products, beverages (colas and other carbonated soft drinks as well as still drinks), canned products, condiments, confectionery products, frozen desserts, jams, jellies, preserves, pickles and wine.

4.3 High Intensity Sweeteners

The sweeteners with the highest market profile in recent years are the artificial sweeteners, especially the high intensity/non-nutritive sweeteners. In particular aspartame as marketed under the trade name NutraSweet has been heavily promoted. This section gives brief details of the non-nutritive sweeteners permitted for use in the U.K. and their principal food applications followed by a general description and uses of the 'bulk' sweeteners.

TABLE 4.9

UK ISOGLUCOSE STATISTICS

tonnes dry matter

	1985/86	1984/85	1983/84	1982/83	1981/82	1980/81	1979/80	1978/79	1977/78
PRODUCTION	27,465	27,487	27,501	27,495	27,645	27,546	27,640	17,842	4,485
IMPORTS FROM EC	9,536	8,518	7,727	6,281	8,540				
IMPORTS FROM 3rd COUNTRIES	-	-	-	-	-				
EXPORTS	107	11	143	142	5				
CONSUMPTION	36,894	35,994	35,085	33,634	36,180				

(Year is July-June)

Sources: Production Figures - Intervention Board for Agricultural Produce, Reading

Import/Export Figures - HM Customs & Excise

Artificial sweeteners are food additives and as such are subject to an extensive regulatory procedure before being allowed into the food chain. The U.K. was unusual in considering a batch of new sweeteners for approval and application in all food uses whereas most countries consider one sweetener at a time and usually for a limited range of applications. In Britain the approval of new food additives is governed by two independent expert committees, the Food Advisory Committee (FAC) and the Committee on the Toxicity of Chemicals in Food, Consumer Products and Environment (COT). The FAC was formed from an amalgamation of the Food Additives and Contaminants Committee (FACC) and the Food Standards Committee (FSC) in 1983. The 1982 report on sweeteners was therefore by the old FACC (MAFF, 1982).

The FACC was first asked to carry out a review of all sweeteners other than sugars in 1977 and reported in 1982. The aim of the FACC review was to look at new and existing sweeteners to assess them for use in food, beverages and table-top use. Before this review saccharin was the only permitted non-nutritive sweetener (The Artificial Sweeteners in Food Regulations, SI 1969 No. 1817) and sorbitol (E420) and mannitol (E421) the only permitted "bulk" sweeteners (The Miscellaneous Additives in Food Regulations, SI 1980 No. 1934). Altogether the FACC were requested to consider 21 sweeteners. Two were withdrawn and another two had been considered elsewhere and were dropped from the report as their primary function in food was not to provide sweetness. One other, thaumatin, was deferred until the results of further tests could be considered and thaumatin was subsequently included in the 1983 Regulations.

The FACC report made the distinction between "intense" sweeteners, that is, substances with a sweetness many times that of sucrose, and "bulk" sweeteners, that is, substances with a sweetness similar to sucrose. However, the 1983 Regulations did not retain this distinction, but this terminology is used in the following sections.

4.3.1 The regulatory procedure

Before entering the food chain a new sweetener has to undergo a number of tests and procedures before reaching the stage of final approval. This falls into two categories: a) having the sweetener pass the regulating body of a particular country, b) getting to this stage and carrying out the experimental, developmental and safety work. Taking the first area a), in the U.K. for a review of a particular class of food additive, such as a new sweetener, four stages are involved. These can be summarised as:

Stage 1 - Submissions requested in additive class review
FAC evaluates "case of need"
COT evaluates "safety in use" if "case of need" accepted
FAC makes recommendations
Stage 2 - Comments on FAC report
New data submitted to FAC
Stage 3 - Proposals for new (or amended) regulations
Comments on proposals
Stage 4 - New (or amended) regulations enacted

Source: Snodin, 1985

The "case of need" included such areas as technological needs, economic requirements, the impact on the appearance and texture of food and consumer benefits, like lower costs, better choice and/or quality of food. The "safety in use" would include the characteristics of the sweetener, its application and projected intake and the toxicological test data. Table 4.10 describes the areas in which data is required for assessing possible human risk for a sweetener:

TABLE 4.10

HUMAN RISK ASSESSMENT FOR A TYPICAL SWEETENER:

DATA REQUIREMENTS

Identification and Characterisation

1. name, structure, formulae
2. specification, impurity profile, analytical procedures
3. chemical and physical properties
4. method of manufacture and quality control checks
5. storage stability

Use/Intake Profile

1. quantity employed for all food used
2. food usage pattern, use levels and residue data
3. degradation (interaction phenomena in use)
4. per capita intake, mean and extreme values
5. intake in special sub-groups, e.g. children
6. advantage to consumer

Toxicological Tests (Species)

1. acute (rat, mouse)
2. genetic toxicology
3. metabolism and pharmacokinetics (rat, dog, man)
4. sub-acute (rat, dog)
5. reproductive toxicology, including teratology (rat, rabbit)
6. chronic toxicity/carcinogenicity (rat)
7. carcinogenicity (mouse)
8. special studies, e.g., biochemistry, immunology, neurotoxicity (various species possibly including man)
9. Ecotoxicity, biodegradability, environmental impact

Safety Evaluation

1. significant toxic effects; dose-response; no-effect levels
2. extrapolation and relevance of animal data to man
3. acceptable daily intake calculations
4. identification of special population groups with higher risks

Source: Snodin, 1983

Taking into account the data requirements and the stages involved in the regulatory procedure, developing a new sweetener is a costly, long-term project taking about ten years from invention to starting the regulatory processes. This procedure is compounded by different requirements made by each country where approval is sought. In this respect Britain has proved to be quite innovatory in its approach to sweetener approval by reviewing a range of sweeteners and their use together, rather than taking each individually, thus making available a batch of new sweeteners in one go.

The time involved in getting a sweetener approved increases the risk for the developing company. The loss of secrecy, competitiveness and using up patent time can all limit the potential to commercially exploit a new sweetener. The need for commercial secrecy on the one hand, but the public approval of safety on the other is an area of potential conflict. The COT, in assessing the safety in use of the sweeteners under review by the FACC, commented in the 1982 report:

> "The information considered was in part supplied by the manufacturers with the rest being obtained by the Secretariat from national and international sources. We are concerned that much of the information considered has not been published... all toxicological information on food additives should be published in reputable journals to enable results to be assessed critically by the scientific community." (p.21)

(Note: Changes to the administration of reviews by COT, for example, require that a copy of all data supplied in support of an application now be lodged with the British Library where it may be read by any interested party.)

The following sections briefly review the permitted artificial sweeteners in the U.K., starting with the non-nutritive sweeteners, saccharin, aspartame, acesulfame potassium and thaumatin (principal source, ISA, 1987). The next section describes the "bulk" sweeteners in more general terms.

4.3.2 Saccharin

Introduction

Saccharin was discovered in May 1878 by the chemists Ira Remsen and Constantine Fahlberg (Walter and Mitchell, 1986) although it was not until the early 1900's that commercial production saw the start of more widespread use. By 1917 saccharin was a fairly common table-top sweetener in America and Europe and the shortage of sugar during the World War II saw an important increase in its usage in food products as well as a table-top sweetener. Saccharin was the only available artificial high intensity sweetener before 1983, following the withdrawal of approval from cyclamates in 1969 (see later).

Description:-

A white crystalline powder. There are a number of salts of saccharin, with the sodium and calcium salts commonly available and approved for food use. Sodium salt is more commonly used since it is more easily soluble (82g/100g) than the calcium salt (67g/100g).

Relative Sweetness:- 300-500 times sweeter than sucrose.

Metabolism:- non-calorific; slowly absorbed, not metabolised and excreted unchanged by the kidneys.

Benefits:- the calories in food and beverages can be reduced by using saccharin rather than sugar for sweetness.

- stable in normal food processing applications and has a long shelf life.
- suitable for cooking and baking.
- synergistic effects when combined with other intense

sweeteners (that is, the combinations of sweeteners are sweeter than the sum of the individual sweeteners).

Limitations:- slow onset of sweetness, unlike sucrose.

- many people find it leaves a bitter, metallic and astringent after-taste, which tends to increase the higher concentration of saccharin.
- doubts over the safety of saccharin have been reported over the years.

Applications:- Saccharin has been used world-wide in an extensive range of applications this includes the following categories:-

- instant beverages
- carbonated soft drinks
- table-top sweeteners (tablets, powder, liquid)
- ice cream
- puddings and jellies
- breakfast cereals
- chocolate
- fish and fruit preservatives
- juices and squashes, ice teas
- chewing gum
- multivitamins
- dairy products
- jams, marmalades
- candies, confectionery
- cider, pickles, sauces
- pharmaceuticals

Status:- saccharin is approved in more than 90 countries.

Accepted Daily Intake (ADI):- 0-2.5mg/kg per day (Commission of the European Communities, 1985 - this source is used for all ADI's for artificial sweeteners reported in this section).

4.3.3 Aspartame

Introduction

L-aspartyl-L-phenylaline methyl ester is more commonly known by its generic name aspartame.

Aspartame was discovered by accident in 1965 by James Schlatter, a chemist working for G.D. Searle and Co. In the U.S. aspartame has had a difficult regulatory history, being approved for dry food use in 1974 only to have approval delayed when Searle's data was questioned. The U.S. Food and Drug Administration finally gave approval in 1981 for dry food use and in July 1983 for use in carbonated soft drinks.

Description:-

An odourless, white crystalline powder with a "clean" sweet taste. It is slightly soluble in water and is sparingly soluble in alcohol. It is not soluble in fats and oils.

Relative sweetness:- It is approximately 200 times sweeter than sucrose.

Metabolism:- Aspartame is a nutritive sweetener and is not absorbed but is first metabolised in the gut as a protein to produce its consistuents phenylalanine, aspartic acid and a methyl ester. These are then absorbed, metabolised and excreted by normal metabolic pathways. Since aspartame is a dipeptide it has 4kcal/g (as do proteins and carbohydrates) but because of the small amounts in which it is used, its calorific effect is negligible. In other words aspartame only provides sweetness and not the other physical properties of other nutritive bulk sweeteners.

Benefits:- has a good taste profile that is very similar to sucrose. Its sweetness develops more slowly and persists slightly longer than that of sucrose.

- enhances and intensifies flavours, in particular citrus and other fruits.
- the calories in food and beverages can be reduced by substituting aspartame for sugars (for example, a tiny amount of aspartame equal to one tenth of a calorie produces the same level of sweetness as a teaspoon of sucrose with 16 calories).
- exhibits synergism with a range of nutritive and non-nutritive sweeteners.

Limitations:- aspartame lacks long-term stability and starts to decompose on prolonged exposures to high temperatures or in liquids. Thus, is cannot be used in food products that are baked or heated during manufacture as its component parts separate with a resultant loss in sweetness.

- it can not be consumed by people suffering from or having a genetic predisposition to the hereditary disease known as phenylketonuria (PKU) which effects 1 in 15,000. These people are unable to metabolise phenylalanine adequately (one of aspartame's metabolites) and need to control the amount of phenylalanine in their diets, including that from aspartame.

Applications:- It is used in a wide variety of foods and beverages and as a table-top sweetener, including the following food categories:-

- dry beverage mixes
- juices
- puddings, fillings, gelatines
- syrups and topping
- table-top sweeteners (tablets, powders)
- chewing gum
- multivitamins
- pharmaceuticals
- frozen desserts
- yoghurts
- carbonated soft drinks
- jams, jellies and marmalades
- chocolate drinks
- breakfast cereals
- sweets and confectionery

Status:- approved for use in 60 countries world-wide in 1987.

ADI:- 0-40mg/kg per day. There is also an ADI for DKP = 0-7.5mg/kg per day, DKP or diketopiperazine being one of the decomposition products of aspartame.

4.3.4 Acesulfame Potassium (Acesulfame-K)

Introduction

Discovered by accident in 1967 by the German company Hoechst A.G. The use of the organic salt acesulfame K in food did not develop quickly after approval in 1983, due to delays in production in Germany.

Description:- A white crystalline powder easily soluble in water.

Relative Sweetness:- 130-200 times sweeter than sucrose.

Metabolism:- It is not metabolised by the body and is excreted by the kidneys unchanged, it is therefore, a calorie-free sweetener.

Benefits:-
- rapid onset of sweetness.
- good stability and can be used in baking and in the preparation of processed foods that need heating.
- reduces calories when used as a substitute for sucrose.
- exhibits synergism with a range of nutritive and non-nutritive sweeteners.

Limitations:- not such a good taste profile as aspartame. A lingering bitter, chemical, synthetic after-taste can be detected by some individuals.
- high concentrations needed to achieve adequate sweetness.

Applications:- This substance has the potential to be used in the same categories as the other sweetners mentioned involving foods that need a heat resistant sweetener.

Status:- As of July 1987 acesulfame K had been authorised in the following countries: Belgium, Federal Republic of Germany, Denmark, United Kingdom, Greece, Ireland, Italy, Sweden, Switzerland, Egypt, Australia, Israel, Jordan, South Africa, United Arab Emerites and Cyprus. Additional approvals are expected in the Netherlands and New Zealand, and petitions for its use are under consideration in a number of countries including the U.S.A. and Canada (it is now permitted for use in U.S.A.).

ADI:- 0-9mg/kg per day.

4.3.5 Thaumatin

Introduction

Thaumatin, or more correctly, its marketed product Talin, is a mixture of sweet tasting proteins extracted from the West African fruit Thaumatococcus danielli. The fruit was first reported in the Pharmaceutical Journal of 1855 although it was not until 1976 that a plantation was set up to study and develop it as a commercial crop.

Description:- an odourless, cream coloured powder.

Relative Sweetness:- around 2,000-2,500 times that of sucrose, with delayed, but prolonged perception of sweetness.

Metabolism:- digested to its constituent amino acids by pancreatic enzymes, as with any other protein, and as such has a calorific value of 4 kcal.g. However, because of the small amounts used its calorific value as part of total energy intake is virtually nil.

Benefits:-
- intensely sweet.
- soluble in freeze or spray dried applications.
- synergism with other sweeteners.
- especially useful as a flavour enhancer and aroma enhancer.

Limitations:-
- liquorice-like after-taste.
- can interact with some food components and sweeteners
- unstable when baked or boiled.

Applications:- Talin is principally used for its qualities as flavour and aroma enhancement, rather than its sweetening effect, but may be used in:-

- coffee drinks
- chewing gums
- savouries
- soya sauce
- yoghurts
- jams and marmalades
- fish products
- pharmaceuticals

Status:- Thaumatin is approved in a small number of countries at present, these include Denmark, U.K., Spain, Switzerland, U.S.A., Canada, Israel, Mexico, Japan, Australia, New Zealand and South Africa.

ADI:- Temporarily acceptable.

4.3.6 Note on Cyclamate

Cyclamate, a calorie-free sweetener, discovered in 1937 and 30 times sweeter than sucrose, is approved in more than 50 countries but was withdrawn in the U.S.A. and U.K. in 1969 following a study in which rats fed cyclamate developed bladder tumours (Goodburn, 1987). It has a wide range of applications and works particularly well in combination with saccharin. Cyclamate carries a temporary ADI of 0-11 mg/kg per day (expressed as cyclamate acid). It is not likely to regain approval in Britain for some time yet.

4.4 Permitted "Bulk Sweeteners"

The use of the "bulk" sweeteners or polyalcohols/hydrogenated sugars, permitted in the U.K. is to date still relatively limited. Many manufacturers see a bright future though, with the trend to "healthy eating" as well as their use in products for people with special dietary needs. For this reason

individual details of each permitted bulk sweetener is not given and technical detail is readily available in the literature (see Hough et al., 1979; Birch and Parker, 1982; Grenby et al., 1983; Nabors and Gelardi, 1986; Goodburn, 1987; and Grenby, 1982).

These sources also give more technical information on the non-nutritive sweeteners and sweeteners that as yet do not have U.K. regulatory approval. For the purposes of this section a general description of the bulk sweeteners and their use in food applications is given.

4.4.1 The manufacture of bulk sweeteners

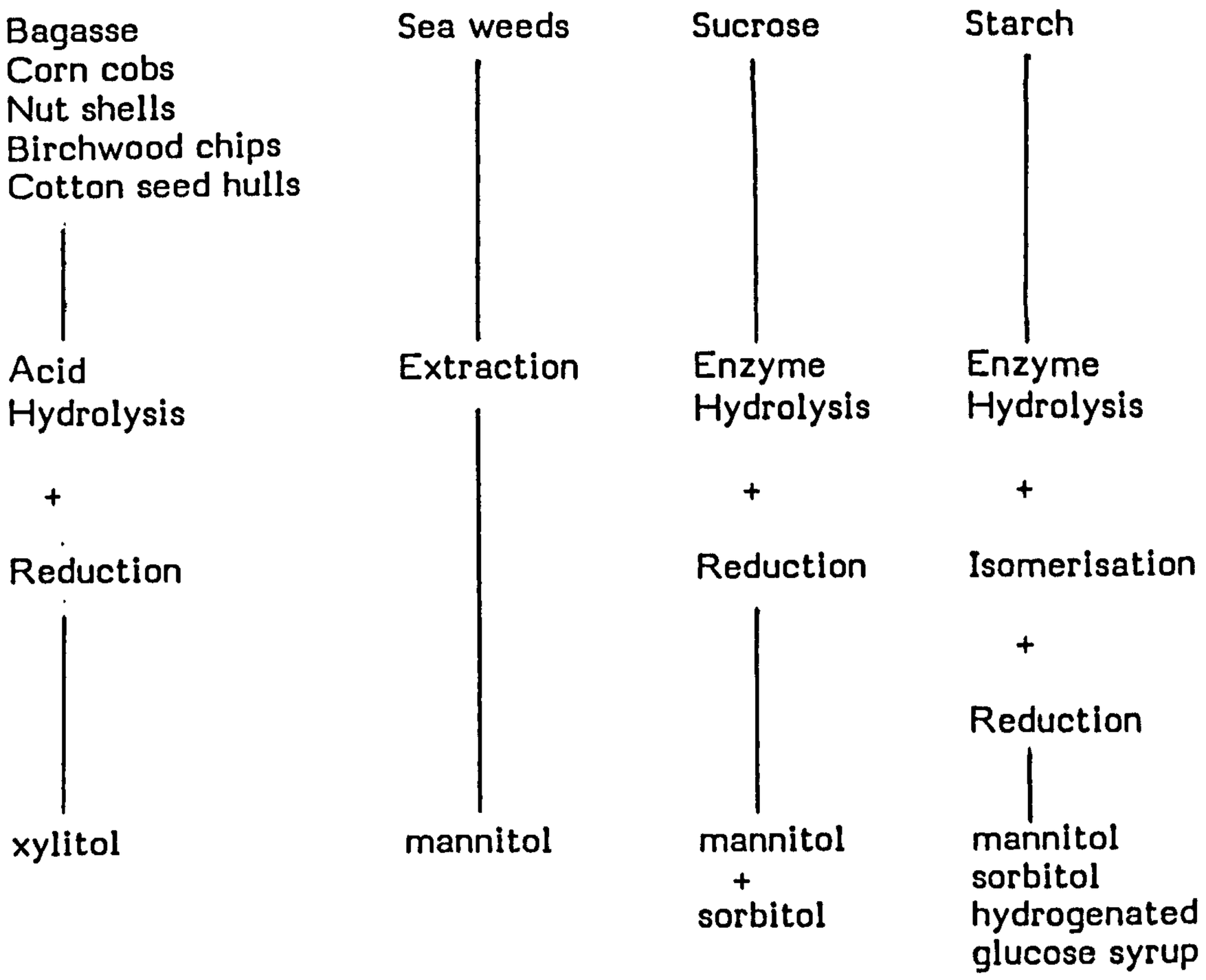
To recap, the bulk sweeteners permitted in Britain are, isomalt, mannitol, sorbitol, xylitol and hydrogenated glucose syrup. Bulk sweeteners are widely distributed in nature, for example, sorbitol was first isolated in 1872 from the berries of the mountain ash tree and mannitol is present in relatively large quantities in seaweed. However, the occurrence of the various bulk sweeteners available from plant sources is not sufficient to warrant commercial extraction. Generally starch - reduced to sugars - is the preferred raw material for the production of the polyalcohols.

The polyalcohols are produced commercially from sugars produced from starch by the reduction of such sugars. Reduction is normally carried out using hydrogen gas under pressure in the presence of a Raney-nickel catalyst. In theory, about 125 litres of hydrogen at atmospheric pressure are required to manufacture one kilogram of a polyalcohol such as sorbitol from glucose. Figure 4.1 shows examples of some of the methods to produce bulk sweeteners and Table 4.11 shows the relative sweetness of various sugars and of the corresponding sugar alcohols.

FIGURE 4.1

EXAMPLES OF THE ORIGIN OF SUGAR ALCOHOLS

AND HYDROGENATED GLUCOSE SYRUPS



Source: Sicard, 1982

4.4.2 The use of "bulk" sweeteners and their food and drink application

Benefits of "bulk" sweeteners

- can be used to replace sucrose in "sugarless foods"
- prevention of dental caries, polyalcohols are less cariogenic than sucrose
- used for special dietary foods, for example, sorbitol can be used in the dietary management of diabetes because its metabolism is largely non-insulin dependent
- some polyalcohols produce a "cooling" sensation in the mouth
- technological uses, for example, a reduced tendency to crystallisation in foods with high carbohydrate concentrations stored at low temperatures

Limitations:

- The major problem with the polyalcohols is that excessive consumption gives gastrointestinal discomfort and often leads to diarrhoea. This is due to the low absorption of sugar alcohols from the gut which results in an osmotic imbalance.

Applications:

Polyalcohols can be and are being used in a wide range of foods, but in particular they have been used in confectionery and related products. The suitability of each polyalcohol to a particular application depends on its individual characteristics, such as xylitol, with its mouth-cooling effect, is used very successfully in chewing gum. Bulk sweeteners can be used in the following foods and drinks:

- hard boiled candy
- toffee, caramels
- chocolate
- bakery goods
- jellies, marmalades
- soft drinks

- chewing gum
- compressed tablets
- coatings, decorations
- canned fruits
- ice cream

ADI:- There is no specific ADI, but because of laxation effects with high intakes consumption of the order of 20g/person/day of polyalcohols is recommended as unlikely to cause undesirable laxative symptoms.

TABLE 4.11

THE RELATIVE SWEETNESS[1] OF VARIOUS SUGARS AND OF THE CORRESPONDING SUGAR ALCOHOLS

Sugar	Sugar alcohol	Sweetness relative to sucrose
Sucrose		100
Glucose		70
	Sorbitol	60
Fructose		150
Mannose		60
	Mannitol	50
Xylose		70
	Xylitol	90
Maltose		40
	Maltitol[2]	50
Starch hydrolysate		25-60
	Isomalt	45-65
	Lycasin 80/33[3]	40
	Lycasin 80/55[3]	55

1. Relative sweetness - these figures should not be considered as exact, but a guide since results vary from the ways in which they are determined.

2. Not permitted for use in the U.K. and produced in significant quantities in Japan only.

3. A proprietary hydrogenated glucose syrup. Lycasin is a registered Trade Mark of Roquette Freres, Leslian, France.

Source: Sicard, 1982

4.5 Food and Drink Manufacturers Response to Changing Attitudes to Sucrose

The British Nutrition Foundation's Task Force on Sugars and Syrups said that is is probable that a maximum of a little over one-third of the 1.5 million tonnes of sugars (sucrose and other sugars) used annually by the U.K. food industry is technically replaceable - that is, more than 500,000 tonnes! (BNF, 1987).

It is not within the aims of this research to consider the technical implications of removing or reducing sucrose in food and drink products, but many products, such as cakes, biscuits and confectionery, would cease to exist as they are now known. Table 4.12 summarises the technical substitutability of sugars in certain food and drink product categories and the estimated market share of artificial sweeteners in these product categories for 1985/86. The following sections consider the use of artificial sweeteners and other changes made by manufacturers to their products in recent years (1983-1987) regarding the use of sugar.

It is a significant response to market changes that many food and drink manufacturers have taken advantage of changing consumer attitudes to sucrose to promote food and drink products that are "sugar free" or contain "no added sugar". Table 4.13 gives some examples of products using "negative" sugar claims as part of their marketing and promotion.

Sugar, or the lack of it, can affect consumer choice. For example, in an analysis of the role of advertising in increasing sales of Kellogg's "Bran Flakes" (Elliott, 1985) the fact that the cereal needed little or no sugar was an important benefit among consumers for buying it (Table 4.14). It is interesting to note that as the advertising campaign continued the benefit of "little or no sugar" as a reason for buying, more than doubled among respondents from 9 to 21%.

TABLE 4.12

THE TECHNICAL SUBSTITUTABILITY OF SUGARS BY FOOD PRODUCT AND MARKET SHARES OF ARTIFICIAL SWEETENERS 1985/86

Food Product	Technical Substitutability of Sugars (% estimate)	Artificial Sweeteners Market ('000 tonnes, w.s.e.)	% of total artificial sweetener market
Soft drinks	100	110	61.1
Cokes	5	-	-
Bicuits/cereals	5	-	-
Chocolate	5	<5	2.8
Sugar Confectionery	10	<10	5.6
Ice cream/yoghurt	100	<10	5.6
Frozen confectionery	100	n.a.	n.a.
Starch/Gelatin Desserts	100	n.a.	n.a.
Pie Fillings/Jams	5	1	0.6
Canned Fruit	100) canned	2	1.1
Baked Beans	100) products		
Other Canned Products	50)		
Pickles/Sauces	100	2	1.1
Meat Products	100	n.a.	n.a.
Brewing/Cider	n.a	10	5.6
Pharmaceutical/Chemical	n.a.	>10	5.6
Miscellaneous	n.a.	20	11.1

Source: Tate and Lyle, 1986

TABLE 4.13

EXAMPLES OF PRODUCTS GIVING A NEGATIVE CLAIM ABOUT SUGAR

Company/Brand	Product	Claim
Hermesetas	Fruit Yoghurt	"sugar free"
Delrosa	Apple and Cherry pure concentrated fruit juice	"no added sugar"
Heinz	Baby meals, 3-9 months	"no added sugar"
Kellogg's	Nutri-Grain	"no added sugar"
John West	Apricot Halves	"no added sugar"
Lockwoods	Blackcurrants in fruit juice	"no added sugar"
Green Giant	Nibblets Sweet Corn	"sugar free"
Heinz	Baked Beans	"no added sugar"
Crosse and Blackwell	Baked Beans	"50% less added sugar"
One Cal	Lemonade	"sugar free"
Asda	Lemonade	"sugar free"
Sutherlands	Salmon Pate	"no added sugar"
Robertson and Sons	Pure Fruit Spread	"no added sugar"

Source: Store check, Asda, Shipley, West Yorkshire, January 1987.

TABLE 4.14

REASONS FOR BUYING KELLOGG'S BRAN FLAKES

	Dec 1981	Jan & Apr 1983	Jly & Oct 1983
% Recent buyers who buy because:			
General health benefits			
Plenty of roughage	38	50	52
Helps keep you healthy	37	41	37
Made from natural ingredients	16	14	14
Rich in vitamins	8	11	18
Digestive benefits			
Contains bran	38	41	31
Ensures healthy digestion	n/a	29	20
Easy to digest	10	12	10
Other benefits			
I like it	23	34	32
Tastes nice	15	20	20
Needs little or no sugar	9	14	21
Purchasing behaviour			
I buy it regularly	14	20	24
Sample base	(120)	(118)	(130)
			Marcos Studies

Source: Elliott, 1985

There has been a marked change in the promotion of foods that exploit perceived consumer worries about sugar in food products. This section chronicles examples of the activities by food and drink manufacturers as regards sugar. To do this the "new products" reported in the magazine "Marketing Week" were examined for the years 1984-1987 inclusive. However, it must be borne in mind these do not represent a totally inclusive list, but serves as a sample of "new products". Products are listed to January 1988, but such activity still continues. Altogether 1,254 "company reports" were recorded. The "company report" refers to the name of the manufacturer, which was recorded, rather than the brand name or the number of "new products" mentioned. Usually under a company report several "new products" were mentioned, for example, one company may have launched four new flavours of yoghurt, this would count as one "company report", not four. "New products" in most cases were not "new" but relaunches or repackaging of old products to update them. However, this was considered more important than if they had been entirely novel products, because it records changes manufacturers were making to existing products in line with consumer changes or how manufacturers wished to change the image of their product. An example of this subtle change in image is Wander Food's Ovaltine. It was reported in "Marketing Week" (August 28, 1987) that a slim, blond Ovaltine girl had replaced the traditional buxom dairy maid to mark the relaunch of the hot drink; it was also labelled "no added sugar". A total of 91 company reports regarding sugar were noted, these were:

<u>February, 1984</u>:

- Sugar Bureau launched a sports sponsorship programme in supermarkets and grocery stores to promote sales and give sugar a healthier image - theme "Energise Sugarwise" and featured pictures of leading sports personalities.

- Billington's advertised its Golden Granulated brand cane sugar in response to the growing health-food sector of the market.

April 1984:

- James Keiller introduced its Shoosh range of low sugar carbonated soft drinks in four flavours.
- Beecham Food lauched Diet Quosh into the diet soft drinks market, using Nutra Sweet. This was the first squash drink to be sweetened with aspartame in the U.K.

May 1984:

- RHM extended its One Cal range of soft drinks with the introduction of sugar-free mixers.
- Heinz launched its first dessert range, Pine Fruit which boasted "no added sugar".
- Colman's of Norwich launched Special R, a low-sugar concentrated fruit drink, incorporating Nutra Sweet as the sweetener.
- £2 million spent by British Sugar in support of its Silver Spoon brands to stem the fall in sugar sales.

June 1984:

- Del Monte introduced 15½oz tins of its Pineapple Chunks in pure natural fruit juice - "no added sugar".
- Cow and Gate launched a selection of "no added sugar" babymeal desserts to its range. According to the company mothers were increasingly concerned about the levels of sugar in food for babies.

July 1984:

- Kellogg's launched a new breakfast cereal aimed at the active and health conscious - called Start, it is made with wheat, corn oats, honey, brown sugar and glucose.
- Panda Drinks extended its range with the launch of Diet Panda in three

flavours, Cola, Orangeade and Lime and Lemonade.

August 1984:

- Bayer U.K. relaunched Sionon Blackcurrant Health Drink for diabetics.
- Mediterranean Growers U.K., a subsidiary of the Italia group, introduced a range of tinned fruit packed in nature juice. The range included pears, peaches, apricots, mandarins and fruit cocktail - they were designed to appeal to the health conscious.

September 1984:

- Welch's of Whitley Bay launched the first sugar-free lollipop in the U.K using Lycasin, a hydrogenated glucose syrup.

October 1984:

- Cambrian Soft Drinks relaunched its range of low calorie soft drinks following a change in formulation to include NutraSweet.

November 1984:

- British Sugar repackaged its Silver Spoon Golden Syrup. They spent £¾ million promoting this product (first launched in 1980).

December 1984:

- Mandora launched a low calorie drink called Jaffa Juice which used NutraSweet.

January 1985:

- Hermesetas lauched, a low-fat, sugar free yoghurt, a similar product was launched by St. Ivel under the Shape brand name in late 1984.

February 1985:

- Anglia Canners added a 12oz can of Sweetcorn to its range, free from both added salt and added sugar.

March, 1985:

- Wells Drink launched cherryade as an extension to its Diet range of

carbonates, marketed under the Wells Wonderful World brand name.

- RHM Food launched two additions to its range of One Cal drinks - blackcurrant and grapefruit and pineapple. The company also introduced its One Cal Plus range of low calorie fruit crushes.
- Harmony Foods added to its Whole Earth range of health products with no added sugar baked beans.

April 1985:

- Corona Soft Drinks extended the Tango range with diet orange and pineapple.
- British Sugar added two lines to its range of Silver Spoon sugars. Silver Spoon Sugar Shapes consists of sugar lumps in the form of hearts, clubs, diamonds and spades and Demerara Coffee Cubes.
- Robinsons launched a new variety into its Ready Drinks range of low sugar orange drinks.
- St. Ivel launched Real a major new yoghurt range. As well as Real the company extended its successful Shape range to include low fat single and double cream, while the Real fruit juice range was extended to include a no added sugar or preservatives mixed-juice variety. The Real yoghurt, containing no artificial additives or sugar was claimed to be the first 'totally pure yoghurt' to be marketed in the U.K.
- Del Monte launched canned fruit in natural juice, a growing sector of the declining canned-fruit market.

May 1985:

- Cow and Gate produced 3 yoghurt desserts for babies, pear, apple and mixed fruit. These all had "no added sugar" and this was displayed on the labels.
- Schweppes launched Natural Tropical Juice a blend of nine fruit juices. The company claimed the blend is 100% pure juice with no added sugar

or preservatives.

- James Robertson and Sons introduced a range of Pure Fruit spreads which contained no added sugar, colours, preservatives or flavouring. At the same time the company relaunched its Today's Recipe 'reduced sugar' preserves range with a new formulation containing 40% less sugar than conventional products. The company's marketing manager was reported as saying the two developments are in line with changes in consumers' eating habits.

June 1985:

- CPC (U.K.) launched Dextrosal Glucose Fruit Drink, a mixture of glucose, orange, passion fruit and lemon juice aimed at the 16-35 year olds interested in sports.
- Kellogg's launched Honey Smacks for children aged 4-12 years old, claimed to be appropriate for today's health conscious market being wheat based and coated with honey rather than sugar.
- Vitaline, a new granulated sugar substitute called Diamin using ascesulfame K as a sweetener.

July 1985:

- Adams Foods introduced four bar multi packs of its Husky chewy cereal bar. Launched in 1984 the product claimed to be high in fibre and low in added sugar.
- Farley Health Products launched a wholemeal rusk; two years ago introduced low sugar rusks which the company claimed lifted static rusk sales from £11 million in 1983 to £12.3 million in 1985.
- Tate and Lyle launched sugar with pectin to develop the speciality sugar market.

August 1985:

- Tate and Lyle test launched Crunchy Toppings, a dessert topping range in

Scotland as another way to sell a sugar based product.

- Kalibu, by Sunwheel Natural Foods, the carob "alternative" chocolate bar was relaunched with sugar-free varieties. This latest activity, which also included the launch of Crunchy, Bran and Raisin Kalibu, followed research which, the company claimed, found that women buy chocolate as a treat but are increasingly aware that they should reduce sugar intake.
- Barr Soft Drinks launched its low calorie version of Irn Bru in England following the success of the product in Scotland.

September 1985:

- Heinz launched its first range of food under the Weight Watchers name to get a greater share of what it saw as a growing market for reduced calorie foods. The range included low calorie soups and salad dressings, also reduced sugar jams, low fat spreads and low fat processed cheese slices. Current (1988) labels on Weight Watchers products such as baked beans and spaghetti prominently display "no added sugar" claims.

October 1985:

- Britvic introduced what it claimed was the world's first low calorie mixer for airline travellers under its Slimsta name.
- Ledbury Preserves introduced De L'Ora exotic mincemeat which it said is made entirely of natural ingredients and contains no added sugar or animal fats.

November 1985:

- Silver Spoon launched Instant Royal Icing.
- A generic campaign for sugar, believed to be the first of its kind, was introduced by Billington's. Billington's press advertising showed the "healthy person's guide to sugar" along with the "unrefined cane sugar symbol". (Earlier Tate and Lyle approached Dorland Advertising to

handle a generic campaign aimed at improving refined sugars' image. However Tate and Lyle failed to reach an agreement on what form the campaign should take.)

December 1985:

- Mediterranean Growers added black cherries to the Valfutta range of fruit canned in natural juices.
- Pillsbury subsidiary, Green Giant Foods, launched a new sweetcorn variety called Niblets with no added salt or sugar.
- Nestle launched Crosse and Blackwell's low salt/low sugar baked beans under a new Healthy Balance label. They have 25% less salt, 50% less sugar, no artificial colourings or preservatives, and 10% fewer calories than standard baked beans.

January 1986:

- Spring Soft Drinks relaunched its range of products and introduced a range of low calorie mixers, diet cola, diet lemonade and tropical crush.
- Heinz announced it was reducing the amount of sugar in its products to make its foods "healthier" although the company declined to reveal by how much.

February 1986:

- Heinz Baby Foods announces it has an on-going programme to reduce sugar levels in all its baby foods. The company predicted that by March 1986, 63 of its 84 varieties would contain no added sugar, making it the largest sugar-free range on the market. Heinz launched its first sugar free range, Pure Fruits, in 1983.

March 1986:

- Wells Drinks reformulated its Black Velvet blackcurrant health drink so the product contained no artificial sweeteners, flavouring or colours.

- G.F. Dietary Group of Companies introduced, under the Country Basket brand name, wholewheat digestive biscuits and diabetic jams with a low fruit sugar content.
- Heinz extended its Weight Watchers range to include reduced calorie baked beans with no added sugar.
- Pepsi Co relaunched Diet Pepsi, claims on the can were: "sugar free. low calorie cola drink". In 1985 20% of all cola sales were accounted for by diet brands.
- General Foods introduced sugar free Bird's Angel Delight, sweetened with NutraSweet.

April 1986:

- Dr. Pepper launched Diet Pepper.

May 1986:

- Newform Foods launched a range of Country Basket jams in individual pots. According to the company the brand is the first sugar free jam to be packed in individual pots.

June 1986:

- Hunter's Foods introduced Crunchy Frootz to the U.K. market - a fruit shaped, low sugar snack in banana, fizzy lemon and fizzy raspberry flavours.
- Crosse and Blackwell added spaghetti to its Healthy Balance range, containing 50% less added sugar.
- The Wrigley Company challenged, in the sugar free chewing gum market, with the launch of the U.K.'s first sugar free gum sweetened with NutraSweet under the Stimoral brand name from Danish Company Dandy Confectionery. The U.K. sugar free market is dominated by Wrigley's Orbit brand (sweetened with saccharin). The chewing gum market has, overall, declined in value by 25% over the past 10 years (worth £55

million), 10% of the market consists of sugar free brands.

July 1986:

- Sodastream restructured its One Cal super concentrated range of drinks.

  The company says its One Cal drinks account for 16% of the total range.

- Kellogg's made its first major attempt to become synonomous with "natural" unprocessed cereals by launching "Nutri-Grain" a wholemeal cereal containing no added sugr.

August 1986:

- Booker Health Foods introduced no added sugar carob-coated fruit bars and flapjacks under its Prewett's label.
- Heinz introduced a no added sugar, low fat rice pudding under its Weight Watchers label.
- Moy Park launched Natural Roast Chicken which it says is the first of its kind on the market because it is completely additive free and has no added salt, sugar or dextrose.
- German Confectionery manufacturer Rayold appointed Spearhead to distribute its Velamints (sugar free mints) in the U.K. Trebor were already selling sugar free Coolmints. The sugar free market accounted for 3% of total mint sales worth £100 million in 1986.

September 1986:

- Waterfood Foods launched a diet variety of its Yoplait yoghurts in four flavours. The yoghurts have a fat content of 0.05% and contain aspartame as a sweetener.
- British Sugar added a maple flavour syrup to its Silver Spoon golden syrup and black treacle range.

October 1986:

- Crosse and Blackwell added backed beans with low fat pork sausages to its Healthy Balance range, having less added sugar.

- Wander Foods, manufacturer of Ovaltine, added a new variety Choc'n'Orange to follow up the success of its low calorie instant drink Choc'n'Mint launched earlier in the year.

January 1987:

- Milupa brought out Camomile Infant Drink to add to its other herbal drinks and it contained very little sugar the company said, if the instructions are followed.
- St. Ivel entered the Fromage Frais market with the introduction of Shape Strawberry and Apricot Fromage Frais. The products contain no artificial colours, preservatives or sugar and have a fat content of 1%.
- Lihn, imported by Trustin Foods, developed a U.K. distribution of a complete range of calorie reduced preserves, diabetic jams, marmalades and sugar free spreads.
- Batchelor's Foods launched Batchelor's Natural Harvest a new brand of marrowfat processed pea canned with reduced amounts of salt and sugar.
- British Sugar planned to forge major new links with retailers to try and halt declining sugar sales and to look at new products in the added value area.

February 1987:

- Confectionery manufacturer Leaf planned to broaden its product range into sugar free and natural confectionery.
- St. Ivel launched Gummi Berry Fruit juice containing no extra sugar.

March 1987:

- Waissel's introduced a range of carob bars under the Canterbury brand name, that contains no caffeine, artificial colouring or flavourings and no added sugar.
- Five Alive replaced sugar in its Five Alive Lite mixed citrus drinks with

an artificial sweetener.

April 1987:

- Vitari (U.K.) launched a frozen fruit dessert low in fat and made from 99% fruit, free from artificial additives colourings and flavourings. The company said it took time to come up with a product that contained real fruit pieces without adding sugar.
- Rowntree Mackintosh relaunched its best selling Sun Pat peanut butter and extended the range to include a no added sugar variety called 'Wholenut'.

May 1987:

- British Sugar spends £1.25 million on a campaign to push its Silver Spoon range. The campaign ran in June mainly through Women's magazines.

June 1987:

- Pepsi and Britvic Corona launched the U.K.'s first major soft drink to be sweetened with 100% NutraSweet.
- Fruisana, a natural sweetener made from fruit sugar and aimed at mothers and athletes, launched by Finnsugar Xyrofin (U.K.).
- Cow and Gate extended their "no added sugar" range of yoghurt desserts for babies.
- Mandora extended its St. Clements range of soft drinks with cola which contained no artificial colourings, sweeteners, flavourings or preservatives.
- Wander Foods extended its range with Choc-O-Lait.
- Reckitt and Colman introduced C-Berry under its Robinsons Baby Foods label, a concentrated fruit juice with no added sugar.
- Itona Products of Wigan extended its Granny Ann biscuits range with Granny Ann high oat biscuits that contain no animal products or added sugar.

July 1987:

- De L'Ora brought out a range of Ledbury preserves with a low sugar content of only 33% sugar.

August 1987:

- A slim, blonde Ovaltine girl has replaced Wander Food's old buxom dairy maid to mark the relaunch of the hot drink. Displays "no added sugar" claim.
- John West Foods brought out a new variety of sweetcorn that had no added salt or sugar. The company said that the no added salt or sugar sector of the canned vegetables market has been growing slowly, but predicted that the market is set for a steady increase in growth.

October 1987:

- Chivers Hartley introduced a speciality mincemeat which contained no added sugar or animal fat.

4.6 Commentary: Introduction

The promotion of sugar reduced or "no added sugar" products has been in areas where it is relatively straightforward to make changes. However, it is also clear that there is a significant market for sugar-free or sugar-reduced products and that this is expanding. When looking at the use of less sugar in food and drink products, three types of change are apparent from the examples given in the previous section:

1. There is the direct replacement of sucrose in a product, such as canned fruit now in 'natural juices' rather than a sucrose syrup.
2. There are claims of "no added sugar" when in many instances this means just "no added sucrose", but other nutritive sweeteners are present, for example, pure fruit drinks and syrups for babies.

3. There is the expanding market for diet and low-calorie products, especially soft drinks and yoghurts, that also claim they contain reduced or no sugar.

Table 4.15 shows, for example, the volume of sales increase in low calorie carbonates in the 1980's in relation to the total market for carbonates.

TABLE 4.15

VOLUME SALES OF LOW CALORIE CARBONATES 1981-1987

(MILLION LITRES)

Year	1. Total Carbonates	2. Low-calorie Carbonates	1-2
1981	2,040	84	1,956
1982	2,180	95	2,085
1983	2,390	139	2,251
1984	2,550	185	2,365
1985	2,735	221	2,514
1986	3,075	281	2,794
1987	3,290	397	2,893

Sources: The British Soft Drinks Association, 1988

Low calorie carbonates have shown dramatic growth, but the volume of full sugar carbonates has also grown, although not at the same rate. The result has been an increase in the total market for carbonated soft drinks, not the direct replacement of full sugar carbonates by sugar-free versions. The same is true for volume sales of yoghurts (NutraSweet, personal communication, 1987).

The response by food and drink manufacturers over the past few years as far as sugar is used as an ingredient, can be considered in two ways. Firstly, the "replacement" market. That is, the product remains the same and often has sucrose replaced by another nutritive sweetener, for example, canned fruit and vegetables, meat products and so on. Secondly, there is the "additional" market, where sweetness rather than sugar is important. This includes the low calorie and diet markets for such products as carbonated soft drinks, dry drink

mixes, low-fat yoghurts and so on. Using this classification the replacement market for products is not so important as the additional market for products. Both can claim to be sugar free or contain "no added sugar", but the additional market expands the overall market of a product category, while the replacement market tends to replace products one for one or remains a small part of the total market. This is an important distinction when considering total sucrose consumption and the impact of dietary advice regarding sugar. These changes in products by manufacturers reflect a growing trend. However, to put these in context the total sugar and sweetener market has to be considered and this is examined in the following sections.

4.6.1 Changes in the total U.K. sugar and sweeteners market

From the late 1960's the search for alternative non-nutritive sweeteners has received a great deal of attention from potential manufacturers. Added to this has been the stimulus of the growing market for low calorie products over the past decade and the efforts to develop suitable replacement bulking agents for the traditional ingredients of fat and sugar. A suitable alternative sweetener should ideally have the following characteristics:

1. It should be at least as sweet as sucrose, be colourless, odourless and have a pleasant, untainted sweet quality, preferably similar to sucrose.
2. It should be water-soluble, chemically and thermally stable.
3. It should display no toxic effects and either be metabolised normally or be excreted completely unchanged.
4. The compound should be relatively easy to manufacture.
5. The compound should fit existing techniques of application and be suitable for using with other existing ingredients where sweetness is required.

6. It should be economically competitive with existing, approved sweeteners.
(Hough et al., 1979)

To date no perfect replacement for sucrose has been developed. Point '6' above is particularly important for the widespread uptake of a new sweetener. It was the increasing price competitiveness of High Fructose Corn Syrups that contributed to the final demise of sucrose in soft drink applications in the U.S.A. (Bujake, 1986). Prices can change very rapidly depending, for example, on new production techniques, market conditions, size of order, the activities of competitors. Table 4.16 gives a 'ball park' guide for the price of a selection of sweeteners in relation to sucrose for 1986/87 when the effective support price for U.K. sucrose was £372,37 a tonne (Agra Europe, 1986).

It can be seen that the bulk sweeteners are especially expensive when compared to sucrose while saccharin is incredibly cheap as a sweetener. In fact saccharin is used in combination with sucrose in many applications to reduce the amount of sucrose used. The U.K. uses more saccharin in food and drink products than the rest of the E.E.C. put together (Harris, 1985).

4.6.2 The size of the total U.K. sugar and sweetener market

This chapter has concentrated on the new industrial use of sugar and sweeteners in food and drink applications; these have to be seen in the context of a number of factors which can be summarised as:

1. The total industrial "mix" of sugar and sweeteners in existing food and drink product ranges.
2. Changing consumer attitudes and behaviour towards food and diet. For example, important influences on consumer choice are food quality and a

"healthy eating" lifestyle, but at the same time food has to be seen as convenient (Taylor Nelson Group, 1987).

TABLE 4.16

PRICES OF SWEETENERS IN COMPARISON TO SUCROSE (per '000kg)

Sweetener	Price/tonne	Relative Sweetnes to sucrose	Relative Price per tonne, w.s.e.
Non-nutritive Sweeteners			
Aspartame	£55,000	200	275.00
Acesulfame K	£45,000	130	346.15
Saccharin	£2,500	300	8.33
Thaumatin	£1,760	2,500	0.70
Bulk Sweeteners			
Sorbitol	£1,120	0.5	2,240
Xylitol	£3,000	1.0	3,000
Mannitol	£2,000	0.6	3,333
Hydrogenated Glucose Syrups	£650	0.7 (syrup)	928.57
		0.9 (dry)	722.22
Isomalt	£2,140	0.5	4,280
(Sucrose	£372.37	1.0	372.37)

Source: Adapted from: Jones, 1987

3. Continued examination of food and diet in relation to health. In Britain a sub-committee of the Government's Committee on Medical Aspects of Food Policy (COMA) is currently reviewing the medical evidence on sugar and health. New research continues to be carried out on the safety of non-nutritive sweeteners.
4. Economic and political considerations, such as the price of artificial sweeteners relative to sucrose and changes made to the EEC's Common

Agricultural Policy (Harris, 1985).

To assess the impact of these different factors total sugar and sweetener consumption has to be considered. Table 4.17 gives an estimate of the total U.K. sweetener market. These figures need to be treated with a little caution as they are based on trade estimates (complete Government statistics are not published). This lack of data also accounts for the slight discrepancies between the figures presented here. The commerical sensitivity about production and sales figures means that they are not readily available for comparison over a number of years.

The majority of sweeteners produced from starch, that is, isoglucose and glucose syrup tonnage, are used in food and drink products, notably confectionery products, brewing and cider, custard powder, gravy powders and soups, soft drinks, jams and preserves (see earlier).

The same holds true for artificial sweeteners, with the majority of artificial sweetener tonnage being used in food and drink applications. For saccharin the principal markets are shown in Table 4.18.

The breakdown by product category for aspartame and acesulfame K is not available (at the time of writing), but can be expected to follow a similar pattern to that of saccharin. Undoubtedly the most successful sweetener, introduced in 1983, in achieving a high profile has been aspartame, as marketed under the trade name NutraSweet. Aspartame now commands more than 1% of the total sugar and sweetener market. The current figures for aspartame tonnage may be higher than 1985/86 due to its use in new products and increased competition from other sources of supply since the patent for aspartame held by NutraSweet's parent company, Monsanto, expired in 1987. A recent advertisement for NutraSweet (Marketing Week, July 3, 1987) claimed: "Products containing NutraSweet have shown dramatic growth".

TABLE 4.17

ESTIMATED UK SUGAR AND SWEETENER MARKET 1985/86

(expressed as white sugar equivalents)

		tonnes w.s.e	% of total	kg/person/ year
Sucrose	retail	750,000	27.4	13.21
	industrial	1,500,000	54.7	26.57
	Total sucrose	2,250,000	82.0	39.78
Sweeteners from starch	Isoglucose	37,000	1.4	0.65
	glucose syrups[1]	266,000	9.7	4.69
	Total starch sweeteners	303,000	11.1	5.34
Artificial Sweeteners	Saccharin (75%)[2]	160,000	5.8	2.82
	Aspartame (20%)[3]	28,000	1.0	0.49
	(Others (5%)	N/A	N/A)	-
	Total Artificial sweeteners	188,000	6.9	3.31
Total UK Sugar and Sweetener Consumption = 2,741,000				48.29

1. assumes sweetness of 0.7 relative to sucrose
2. assumes sweetness of 300 relative to sucrose
3. assumes sweetness of 200 relative to sucrose

TABLE 4.18

SACCHARIN USED IN FOOD AND DRINK (1987)

	tonnes	% of total
Soft drinks	399	74.8
Other Food	81.9	15.4
Table-top/Retail	52.5	9.8
Total	533.4	100

Source: personal communication Boots PLC, 1987

Particularly, featured were colas (up 38%), fruit flavoured carbonates (up 40%), yoghurts (up 66%) and table-top sweeteners (up 110%), however the advertisement did not say whether the increase was in volume or by value, it is assumed by value of retail sales. Market information on the bulk sweeteners in the U.K. is not given because sufficient data is not available.

In summary, looking at the total industrial sugar and sweetener market, sucrose holds around 82%, sweeteners from starch 11% and artificial sweeteners 7%. The majority of these sweeteners are used in food and drink applications, with the most important market for starch sweeteners being confectionery and for artificial sweeteners, soft drinks. This gives a total consumption figure of 2,741,000 tonnes w.s.e. of which aroud 70% (1,918,700 tonnes w.s.e.) is used in food and drink applications. Currently the usage of artificial sweeteners has risen to around 10% of the total sugar and sweetener market (Tate and Lyle, personal communication, 1988).

4.6.3 Future considerations

As shown earlier (Chapter Three), sucrose consumption in Britain is in long-term decline and recent dietary guidelines have suggested yet further reductions in average sucrose consumption on the grounds of better health (no more than 20 kg/person/year or 1,120,000 tonnes, w.s.e. of sucrose - NACNE, 1983). In the past five years the U.K. has seen as "Food Revolution" (Wheelock, 1986) centred around "healthy eating". This has come at just the right time for the promotion of artificial sweeteners. Consumers are now not only interested in low-calorie products as part of slimming diets, but as part of a more general healthy lifestyle. Although, for example, diet soft drinks containing artificial sweeteners still claim they can only help as part of "a calorie controlled diet", the current marketing platform concentrates on "taste".

Many manufacturers and large retailers have taken the opportunity to promote products as containing "no added sugar" or as "sugar free".

Interestingly, recent claims for some soft drinks have taken to claiming to contain "no saccharin". The Well's "Diet Plus" range, for example, which uses an acesulfame K and aspartame sweetener mix, said in a trade advertisement: "No Sugar, No Saccharin, Just Taste" ('The Grocer', April 9, 1988). This statement just about sums up the state of the marketing art as far as sweet-tasting, low calorie products are concerned. Another trend is the continuing switch to products sweetened exclusively with one particular sweetener and promoted as such, for example, Diet Pepsi (in 1987) and Diet Coke (in 1988) have both changed to 100% NutraSweet rather than aspartame/saccharin blends.

Developing a new artificial sweetener is a high risk business costing many millions of pounds in research and development and taking eight to ten years from invention to the first petition to regulatory bodies (Snodin, 1983). The next major step in the development process is getting the sweetener approved by the different regulatory bodies in the principal markets. There is also the problem, well illustrated in the history of artificial sweeteners, of new food additives coming under the scrutiny of a vociferous and strong consumer movement suspicious of industry "tampering with our food supply". In Britain, as in other countries, the success of artificial sweeteners is tied to the soft drinks industry's ability to sell "nothing" to the consumer, or, more correctly, take out the sucrose in soft drinks and replace it with water and a minute amount of an artificial sweetening agent.

For the U.K. the potential number of soft drink customers is limited to around nine companies who control more than two-thirds of the soft drinks market. Coupled to this is the increasing patent activity world-wide for aspartame and other dipetide sweeteners for use in various food and drink applications, hence restricting its attractiveness to a potential customer. This at the same time, ironically, also makes the development of a new artificial

sweetener more attractive in the face of this entrenched competition for applications with existing sweeteners (Mackay, 1987).

Interestingly, the development of a food market segment using artificial sweeteners has, at present, not been at the direct expense of sucrose or other nutritive sweeteners. In fact there has been increased growth in the whole market, including growth in some sucrose only product ranges. In some instances the creation of a "sugar free" niche has also stimulated demand for the full sugar varieties (British Sugar, personal communication, 1987). In fact, the industrial purchases of sucrose have increased slightly in recent years despite the fact that the retail market for white granulated sugar is continuing to decline and overall the total sugar and sweetener market has remained the same.

Thus in conclusion, for the future of the total sugar and sweetener markets there are a number of apparently contradictory factors that make long-term planning uncertain for the U.K.. The main points are summarised below:

1. For the British consumer the number one food and diet worry appears to be food additives (Taylor Nelson Group, 1987). Yet artificial sweeteners seem to have escaped this attention except, perhaps, saccharin may become targeted by consumers as a number of manufacturers are "knocking" saccharin in their promotional activities. In fact artificial sweeteners are the only food additives that are positively promoted and large sums of money spent advertising products using them and pointing out their benefits. More generally, how big a part does food safety play in consumer choice and is this reflected in sugar and sweetener consumption?

2. Increasing competition - this is between sugars and sweeteners and the principal markets that are their main outlets. There are a limited

number of potential customers who manufacture mass market products using sweeteners who can easily develop, say, ranges using artificial sweeteners.

3. The revival of sucrose as a "natural" product.

4. Lack of suitable, cost-effective, safe replacement bulk for sucrose in sugar-containing foods. One sucrose replacement, approved for use in the U.K., is Polydextrose a low-calorie bulking agent (1 kcal/g), manufactured by Pfizer Chemicals, however this costs around £1,850 a tonne.

5. Does the consumer and the industrial customer want or need artificial sweeteners?

a) The industrial customer, while accepting niche marketing opportunities, may be reluctant to change tried and tested technology and production methods for its mass market products.

b) Is there a definable extent to consumer needs (and hence markets) as far as alternative sweeteners to sucrose are concerned?

c) More traditional factors such as social class, price, food "fashions" and availability equally have a role to play in the uptake and use of sugars and sweeteners.

6. Political considerations - sugar production is controlled and governed by protective government and international bureaucracies. New sweeteners and bulking agents have to face complex regulatory procedures before being approved for use.

4.6.4 Summary

The most dynamic area of the industrial sugar and sweetener market in recent years has been the promotion of product ranges using artificial sweeteners. These account for around 188,000 tonnes w.s.e. which is around 7% of the total U.K. sugar and sweetener market. Most of this use is in manufactured food and drink products. The promotion of "diet", "low calorie" and "light" products, often at the expense of sucrose, has been supported by substantial advertising and promotional campaigns creating notable market niches for these products. Except for continued growth and use in soft drinks, where the low calorie sector is expected to be 20% of the total market by the 1990's, the expansion of artificial sweeteners into other mass market product areas appears to be much more limited.

The consumption of isoglucose has been steadily increasing throughout the 1980's, but further large increases seem unlikely unless the EC Sugar Regime is reformed. The position of glucose syrups in food and drink manufacture is also tied to the politics of the CAP and its Starch Regime. The major substitution of sucrose by glucose syrups occurred mainly before 1973 and consumption in the 1980's has been relatively stable.

Many manufacturers use a combination of sugars and sweeteners in their product ranges. Recent years has seen a growing market for "no added sugar" and "sugar free" products. Consumers continue to express doubts about sugar as a food and are cutting back on eating it in its white granulated form. These doubts about sugar, in turn, are further reinforced by dietary guidelines which stress the importance of cutting back on sugar in manufactured food and drink products. How do food and drink manufacturers regard the issue of sugar, diet and health and its impact on their business? The next Chapter examines this issue in detail.

CHAPTER FIVE

THE 1988 NATIONAL SURVEY OF SUGAR AND SWEETENER USERS

5.1 Introduction

One of the major aims of this research is to describe and if possible quantify the impact of dietary advice on sugar consumption since 1983 as it has affected the U.K. food industry that purchases sugar. As shown earlier, large sections of the food industry use sugar as a major part of their product ranges and this chapter examines the attitudes of food and drink manufacturers towards the issue of sugar, diet and health.

In this respect the aims of the study reported in this chapter are as follows:

1. To assess whether dietary advice on sugar has affected all sections of the food industry which produces products with sugar as an important ingredient. Or, in other words, is there a consensus of opinion on this subject.
2. To discover if there are any noticeable differences between food and drink manufacturers on the subject of sugar, diet and health, for example, is company size important?
3. To produce a firm statement of the impact of dietary advice on food and drink manufacturers.
4. To obtain a representative sample of food and drink manufacturers across product ranges that use sugar.
5. To identify further areas for research.

Two research techniques are available for use in this type of work: a questionnaire by personal interview and a postal questionnaire. The personal interview method was considered inappropriate for several reasons, in

particular the resources required, for example extensive travelling, time factors and achieving a representative sample. A self-administered attitudinal postal questionnaire was selected as being the most appropriate method by which to examine the areas above. This method was used for a variety of reasons and these are explained in section 5.2.1.

However, first, what is meant by "attitudinal". An "attitude" has been defined as:

> "... the predisposition of the individual to evaluate some symbol or object or aspect of his world in a favourable or unfavourable manner... attitudes include the affective, or feeling core of liking or disliking and the cognitive, or belief elements which describe the effect of the attitude, its characteristics and its relations to other objects." (Katz, 1960)

In other words an attitude towards any concept is simply a person's general feeling of "favourableness" or "unfavourableness" for that concept (Ajzen and Fishbein, 1980). In this case the "concepts" are statements on sugar, diet and health as they may or may not relate to a food and drink manufacturer. The rationale behind an "attitudinal" study is that appropriate measures of attitude are strongly related to action and that human beings are usually quite rational and make systematic use of information available to them, although attitudes can be one of many factors that influence behaviour (Ajzen and Fishbein, 1980). Using the "feeling of favourableness or unfavourableness" for a concept in the format of a questionnaire is one of the most widely used research tools available for the social scientist (Oppenheim, 1966).

Dietary guidelines and goals have been directed towards the general population and it was therefore decided that a large-scale generalized survey was needed aimed at a representative sample of industrial sugar users since:

> "... there is really no alternative to the use of standardised questionnaires in large scale surveys." (Sheatsley, 1983)

It also fits in with the wider aims of "policy" as opposed to strictly "theoretical" research (Hakim, 1987; Timmer et al., 1983).

No similar published survey testing food and drink manufacturers attitudes to the impact of dietary recommendations aimed at sugar eating has been found in the literature and in this respect, this research is considered exploratory rather than repetitive of previous research.

5.2 Methods

5.2.1 Self-administered postal questionnaires

There are a number of advantages and disadvantages to using a self-administered postal questionnaire for data collection. Some of the main disadvantages in respect to this research are listed below:

1. possible low response rate
2. poor mailing list not giving a representative sample
3. the danger of questions being misread or misinterpreted
4. only a one-off chance introductory letter to motivate potential respondents
5. reliance on respondents to be interested enough to complete questionnaire fully and actually return it
6. respondents have the chance to read all the questions before answering
7. it is not possible to probe deeper into comments or answers made by respondents.

These have to be weighed up and taken into account with the advantages to be gained from a postal questionnaire, although an awareness of the disadvantages is relevant to any final interpretation of a completed survey. The advantages of a self-administered questionnaire for the particular aims of this research seemed to preclude other methods and any potential disadvantages. The advantages were seen as:

1. mailed questionnaires are cheaper than most other methods
2. it would be less time-consuming to undertake
3. it is possible to get a widely spread sample, especially geographically
4. it eliminates interviewer errors
5. it can be passed to the appropriate person for completion
6. there is the chance for considered answers, especially if an answer requires consultation with documents
7. it overcomes non-contact, there is a greater probability that the questionnaire will reach a target person who can either complete it themselves or authorise its completion
8. there is slight evidence respondents will make critical comments and report less socially acceptable responses somewhat more readily on a mailed questionnaire (Moser and Kalton, 1971).

In particular, the problem of very limited resources for Science and Engineering Research Council studentships was an important consideration in deciding on the research methods. With this in mind the members of the Food Policy Research Unit and the author's supervisors have to be acknowledged for the confidence shown in the research in providing the additional financial support needed that finally made the questionnaire possible.

5.2.2 The sample frame

The sample frame was selected firstly by considering the types of food and drink categories that account for the majority of sugar used in food and drink manufacturing and, secondly, the distribution of this use between industrial users. To recap on the principal food and drink categories (see Table 3.10 for more detail), these are:

soft drinks

baking, biscuits and cereals

chocolate and sugar confectionery

ice-cream, yoghurt and frozen desserts

canned fruit and vegetables

jams and jellies

others

(Pharmaceutical use was excluded from the sample frame.)

The distribution of industrial customers, in terms of tonnage bought, was considered next. This is extremely difficult to calculate accurately (British Sugar, personal communication, 1988), but the 1981 Monopolies and Mergers Commission provides a rough guide.

TABLE 5.0

THE DISTRIBUTION OF INDUSTRIAL CUSTOMERS 1981

No. Customers	Annual Consumption	U.K. Market Share (%)
15	over 20,000 tonnes	47
30	5,000-20,000 tonnes	20
215	350-5,000 tonnes	18
1, 500-2,000	under 350 tonnes	15

The figures in Table 5.0 can only be treated as broad brush with there probably now being slightly more customers at the top end controlling an even larger share of the total market. However, the figures indicate the importance of reaching the top 260 or so industrial customers for sugar. For the larger users these are self-evident from the literature, for example, Mars, Rowntree and Cadbury in chocolate products; Pepsi-Cola and Coca -Cola (Britvic-Corona and Schweppes respectively) for soft drinks: Rank Hovis MacDougall, United

Biscuits and J. Lyons for baked products, Heinz for canned products, Kelloggs for cereals and Premier Brands for jam.

To draw up a sample frame to include these major manufacturers but also to include medium and smaller sized companies the Foods Trade Directory and Food Buyers' Yearbook 1987/88 was consulted. Using this and trying to check for any omissions, a sample frame of 800 companies was created for mailing the questionnaire to.

5.2.3 General design of the questionnaire

5.2.3.1 The attitudinal statements

The questionnaire consisted of three sections. Section One consisted of 22 attitudinal statements on the European Community Sugar Regime; Section Two 24 attitudinal statements about Sugar, Diet and Health and Section Three nine questions requesting information about a respondents company. For the purposes of this thesis Section One is not being considered, although the full questionnaire is reproduced in Appendix A. The analysis here deals with just Section Two and Three.

The origins of the 24 attitudinal statements about sugar, diet and health lie, firstly, in the literature but mainly from a series of interviews with key personnel in the sugar industry, trade associations, academics and the attendance of relevant conferences and seminars. This work included meetings at:Tate and Lyle plc

British Sugar plc

The World Sugar Research Organisation

The Sugar Bureau

The Biscuit Cake Cocoa and Chocolate Alliance

NutraSweet A.G.

Hoechst A.G.

Tunnel Refineries Ltd.

consumer and interested pressure groups

a number of food and drink manufacturers

Consultation with people from these organisations together with the relevant literature raised the issues covered by the attitudinal statements and the overall "impression" of the survey.

Using the information gained from the above sources the attitudinal statements were designed around four general headings:

a) Healthy eating and sugar eating - general perceptions about dietary change. The following statements come under this category:

Q1 Sugar is a natural part of a balanced diet

Q12 The recommendation by some health experts that average UK sugar consumption should be cut by half is a realistic target

Q13 It is up to the individual to think about whether they are getting a balanced diet

Q14 A small reduction in average sucrose consumption would be better for the nation's health

Q15 The "healthy eating" lifestyle is here to stay

Q17 My company is fully aware of the dietary recommendations that talk about average sucrose consumption

b) Changes food and drink manufacturers have noticed, made or have considered making regarding sugar and their company's products. The following statements come under this category:

Q4 Consumer attitudes towards sucrose have encouraged my company to

develop products using alternative sweeteners

Q7 Consumers making changes to their diet in recent years has resulted in lower sales of some of my company's products

Q10 Consumer views on "healthy eating" have played only a small part, if any, in my company's marketing strategies to date

Q18 Consumer attitudes to sugar have resulted in lower sales of some of my company's products

Q19 Factors other than consumer attitudes to sugar are more important to the success of my company

Q22 Sugar-reduced or sugar-free products will always be a small segment of the total market in which my company sells

Q23 In the long-run the sugar, diet and health debate is of little or no relevance to my company's success

Q24 My company now considers it worthwhile to explore manufacturing products using sweeteners other than sucrose

c) Food and drink manufacturers' opinions on possible consumer behaviour regarding sugar consumption. The following statements come under this category:

Q3 A small number of consumers are worried sugar might be bad for their health

Q6 Cutting back on sugar consumption by consumers is just another eating fad

Q8 Consumers are confused about what is and what is not a healthy and balanced diet

Q9 Consumers are not very interested in their individual sugar consumption

Q16 The majority of consumers are worried sugar might be bad for their

health

Q20 The majority of consumers are actively trying to cut down on their individual sugar intakes

Q21 Current consumer concerns about diet and health will make no difference whatsoever to average sugar consumption in the long run

d) The functional use of sugar. The following statements come under this category:

Q2 Sugar is used by my company for a combination of its technical properties

Q5 Taste is the most important reason why my company uses sugar as an ingredient

Q11 It is "technically" possible to reduce some of the sucrose in my company's products

Some of the attitudinal statements overlap between the four categories. In total, the attitudinal statements were designed to confirm knowledge or awareness of the issue by respondents, their interest in the problem or concern about it, the direction of their attitudes on the subject and how strongly the attitudes are held and what actions, if any, have been taken. The tone of the statements were personalised around a "company" rather than an individual. For all the attitudinal statements a six point Likert-style scale was used ranging from "completely agree" to "completely disagree". The choice of "don't know" was omitted on the belief that is presents an easy, lazy answer that respondents will tend to choose if it is an available option (Sheatsley, 1983). There were only two respondents who indicated they wanted to answer 'don't know' to a number of statements.

Section Three was used to obtain company information to use as a basis for analysis. This included questions on company size and profile (Q1, 2, 3, 4, 9) an indication of marketing activity regarding healthy eating (Q5, 6) and an indication of sugar and sweetener usage (Q7, 8).

5.2.3.2 The physical questionnaire design

Crucial to any successful direct mail operation - in this case a questionnaire - is the design of the mailing (Brann, 1984). In this case the questionnaire was designed as an A4 "booklet" and made to look and read as simple as possible. To achieve this the questionnaire was typed with plenty of spacing with an unimposing typeface. A novel title page was added together with the creation of an important sounding title for the whole project - "The 1988 National Survey of Sugar and Sweetener Users" to furnish an air of grandeur and confirm the professional nature of the survey. The back page was used to invite additional comments from respondents and at the same time to express appreciation to the respondent - "Thank you for your help and co-operation".

The attitudinal statements were ordered so the potentially most interesting and topic-related questions came first. Finally a simple format for answering was adopted - just circle one alternative - so completion was not demanding or time-consuming. The overall aim was to make the questionnaire interesting and relevant to a company using sugar as an important ingredient.

As well as a questionnaire, each mailing included a pre-paid envelope and a covering letter designed to explain and motivate the potential respondent - see Figure 5.1. The covering letter stressed the importance of the survey and the company's participation in it and offered social rewards in return, that is, how the study would prove important to their business and offering a tangible reward in the form of the major findings from the survey. More than 250

Figure 5.1 Covering Letter

University of BRADFORD

Food Policy Research Unit
Head
Dr J VERNER WHEELOCK

Bradford West Yorkshire BD7 1DP
United Kingdom
telex 51309 UNIBFD G
☎ 0274 733466 ext 578/6133

MH/JME

January 1988

National Survey of Sugar Users

I am writing to ask for your help in an important national survey of food manufacturers who use sugar and sweeteners.

The survey forms part of a comprehensive research programme assessing the use of sugar and sweeteners by the food industry. To make this a success I am asking you to complete and return the enclosed questionnaire.

The questionnaire surveys your opinions on the European Community Sugar Regime and consumer attitudes to sugar, diet and health. To this end the questionnaire has been designed to be filled in as quickly and easily as possible. On the last page a space is provided for your own comments.

It is an independent academic study not identified with any commercial interest. The research is funded by the Government's Science and Engineering Research Council and full confidentiality is assured.

An addressed, pre-paid envelope is enclosed to return your completed questionnaire. If you have any enquiries please do not hesitate to contact me.

Thank you in advance for your help and time.

Yours sincerely

Michael Heasman
Food Policy Research Unit

Once analysis of the survey is finished a free summary of the major results will be made available for your records. If you would like a free copy please fill in and return this slip.

Name _____

Address _____

requests for this were received. Finally, the confidential and independent nature of the research was also pointed out.

The questionnaire, pre-paid envelope and covering letter, each one individually signed by the author, was sent out in A4 envelopes so the appearance of the mailing was not spoilt by folding. Where possible the covering letter and envelope was addressed by name to the company managing director, obtained from the Food Trades Directory, and where no name was available a special stamp was used saying in bold letters: "For the Attention of the Managing Director".

5.2.3.3 The time schedule of "The 1988 National Survey of Sugar and Sweetener Users"

The survey lasted for seven weeks, between January 25 and March 11 1988. During Week Three a reminder letter was sent out, the letter for this, following the same principles as the first covering letter, is shown in Figure 5.2. The type of response fell into four categories. Firstly, companies that were no longer at the address used or had gone out of business, in these cases the mailing was returned by the Post Office. Secondly, companies that replied saying they were either not manufacturers or giving a reason why they did not wish to participate in the survey. Thirdly, there were the completed questionnaires and then fourthly, the non-respondents. The detail of the seven week's campaign and the weekly response rates is given below:

Figure 5.2 Reminder Letter

University of BRADFORD

Food Policy Research Unit
Head
Dr J VERNER WHEELOCK
Bradford West Yorkshire BD7 1DP
United Kingdom
telex 51309 UNIBFD G
☎ 0274 733466 ext 578/6133

MH/JME

18 February 1988.

Dear Sir

The 1988 National Survey of Sugar and Sweetener Users

If you have already responded, thank you for your co-operation and please ignore this reminder.

Further to my letter in January, I am writing again to ask for your help in filling out and returning the enclosed questionnaire, which surveys your opinions on the European Community Sugar Regime and consumer attitudes to sugar, diet and health.

Bearing in mind this research examines important changes that are affecting the food industry, I hope you will decide that it is worth investing a little of your time. The questionnaire has been designed to be filled in as quickly and easily as possible and a pre-paid envelope is provided.

I would like to stress that it is an independent, Government-funded, academic study not identified with any commercial interest and full confidentiality is assured.

A summary of the major findings is to be made available, free of charge, to all participants. To receive your copy return the slip below together with your completed questionnaire.

Your co-operation would be greatly appreciated, please help.

Yours faithfully

Michael Heasman
Food Policy Research Unit

I would like to receive a copy of the major findings of the 1988 National Survey of Sugar and Sweetener Users. Please send my copy to:

Name _____

Address _____

_____

	Completed Quest.	Returned with reason	No longer at address	Total
WEEK ONE				
(Jan 25 - 29)	60	60	21	141
WEEK TWO				
(Feb 1 - 5)	41	24	7	72
WEEK THREE				
	(REMINDER LETTERS SENT OUT)			
WEEK FOUR				
(Feb 15 - 19)	56	35	16	107
WEEK FIVE				
(Feb 22 - 26)	26	8	3	38
WEEK SIX				
(Feb 29 - March 4)	11	6	0	17
WEEK SEVEN				
(March 7 - 11)	21	2	0	23
TOTALS	241	139	49	429

A number of completed questionnaires were returned after Week Seven but these were not included in the final analysis. Out of the total number of questionnaires sent out (800), 53.6% were accounted for. From the total 6.13% were no longer at the address mailed or had gone out of business, 17.38% returned the questionnaires and/or wrote explaining why they were not completed and 30.13% filled the questionnaire in. Of these 224 (28%) were used for analysis, the other 17 completed questionnaires being from non-manufacturers.

5.2.3.4 Comments on failure to complete questionnaire

The main reason given for the failure to complete the questionnaire was that the company was not a U.K. manufacturer. Many of the companies mailed turned out to be wholesalers, importers or brokers; in fact a surprising aside to the survey was how relatively few companies actually manufacture products in Britain.

The next most common reason given for non-response, but accounting for only a small percentage compared to the above reason, was on the grounds that the questionnaire was requesting confidential information. However, this potentially serious problem to the success of the survey turned out of only minor concern. Most companies - from household names to one-man operations - were quite candid or simply left blank the one or two questions they did not want to answer.

Another problem encountered was the head office of large groups stopping individual company's in the group replying. For example, one head office recalled all the questionnaires that individual companies in the group had completed (about eight) and then said they were unable to give a group reply. Interestingly the director of one head office who recalled the questionnaires had studied the completed answers from the various companies in the group and found them: "very revealing and informative"!

Other reasons for non-response were that for small manufacturers Section One on the European Sugar Regime was "too technical", the questionnaire was considered "not relevant", "too obvious" or companies were "too busy" to fill it in. Throughout the seven week campaign there was only one personal complaint on why was the survey being carried out on the particular subject area.

5.3 Results

5.3.1 Introduction

The Results section is split into five sub-sections, these are as follows:

1. A description and discussion of the demographic characteristics of the respondents to establish how far they are a representative sample.
2. A descriptive analysis of the attitudinal statements on sugar, diet and health giving the features of the survey aggregate.
3. A factor analysis using the attitudinal statements. The factor analysis uses intercorrelations among variable ratings to infer underlying dimensions common to groups of respondents.
4. An univariate and multivariate discriminant analysis. This technique relies on the relations between each attitudinal variable and a particular criterion, for example, company size.
5. An analysis of the invited comments made by respondents on sugar, diet and health issues.

All analyses was carried out using SPSS programmes (Norusis, 1985).

5.3.2 Description of respondents

5.3.2.1 Company profile

Section Three of The 1988 National Survey of Sugar and Sweetener Users was designed to build a profile of the respondents. In the first instance to establish the type of company; secondly, whether the company had already been promoting products that made health claims and finally, to establish the extent of sugar and sweetener usage.

Respondents to Question 2 (n=219) described themselves as manufacturing a total of 67 product types; these are listed in Table 5.1. Taking the first ranked product category and assuming respondents followed the instructions to rank their company's product categories in order of

importance, the manufactured products of respondents fall into nine broad categories. These categories and number of respondents in each is listed in Table 5.2. This profile of respondents by product category matches very nicely with the distribution by product category of the industrial use of sugar (see Table 3.10). The spread of respondents over product categories embraces all the major areas where sugar is used in manufacturing. There is, perhaps, a slight bias towards sugar confectionery, but if this is combined with chocolate confectionery it would give a more representative sample of total confectionery and sugar usage.

Tables 5.3, 5.4 and 5.5. gives an indication of the size and type of company defining them into, small, medium and large companies. There are many definitions for different size of company. The definitions used here are very much "ball-park" figures taking all the different definitions (more than 70) of company size in the literature and more specifically are those argued by Piercy, 1983; Schlegelmilch et al., 1986 and Hooley and Brooksbank, 1986.

The number of employees (Table 5.3) is split nearly 50:50 (n=223) between small companies with less than 100 employees and those with more than 100 employees, with large companies, by number of employees (>501), representing just under a quarter (23.8%) of respondents. The annual turnover of respondents (Table 5.4, n=222) gives a more even distribution between companies with more than 60% having a turnover greater than £2.5 million per annum, but the same number of medium and large companies, 30.2% each respectively. The majority of companies (Table 5.4, n=222) described themselves as fully independent/autonomous (62.2%), while 8.6% said they were effectively under the control of a larger group. This suggests the vast majority of respondents would have completed the survey in the light of their company's individual circumstances over which they had a large degree of control.

TABLE 5.1

THE RANGE OF PRODUCTS USING SUGAR AND SWEETENERS AS AN INGREDIENT MANUFACTURED BY COMPANIES TAKING PART IN THE SURVEY

Biscuits
Breakfast cereals
Cakes and gateaux
Cheesecakes
Chocolate confectionery
Flour confectionery
Sugar confectionery
Dessert mixes
Desserts
Fondants/icing/coatings
Ice-cream/lollies/sorbets
Jams/preserves/conserves
Soft drinks
Yoghurt
Sauces
Mincemeat
Sugar-free iced confectionery
Mustards
Toffee
Syrup
Canned and bottled vegetables
Honey
Sherry/perry/wine
Canned meat products
Canned soups
Cake mixes
Milk powderds
Baby meals
Liquorice
Fresh cream desserts
Meringues
Boiled sweets
Slimming products
Salad dressings
Cottage cheese
Sweetened condensed milk
Soft drink powders
Flavours
Chocolate powders
Pies
Sugar
Pastries
Canned and bottled fruit
Flatbread
Jellies
Squashes and cordials
Beer
Mousses
Cereal bars
Roast/cooked poultry
Fudge
Bread
Flavoured cooked poultry
Glace cherries
Cut mixed peel
Carbonated soft drinks
Pickles
Dehydrated soups
Liequeurs
Cider
Pectin
Tablets
Sweets
Flavoured milk
Custard
Ready meals

TABLE 5.2 MOST IMPORTANT PRODUCT CATEGORIES OF COMPANIES TAKING PART IN SURVEY

Product Category	No. Companies	% of total
Soft drinks	33	15.1
Cakes	21	9.6
Biscuits	19	8.7
Cereals	4	1.8
Chocolate confectionery	10	4.6
Sugar confectionery	42	19.2
Ice-cream/yoghurt/frozen desserts	30	13.7
Jams/preserves/jellies	20	9.1
Miscellaneous	40	18.3

(n=219)

TABLE 5.3 NUMBER OF EMPLOYEES OF RESPONDING COMPANIES

	No. Companies	% of total
Less than 100 employees	110	49.3
101-500 employees	60	26.9
More than 501 employees	53	23.8

(n=223)

TABLE 5.4 ANNUAL TURNOVER OF RESPONDING COMPANIES

	No. Companies	% of total
Less than £2.5 million	88	39.6
£2.5 million to £20 million	67	30.2
More than £20 million	67	30.2

(n=222)

TABLE 5.5 STATUS OF RESPONDING COMPANIES

	No. Companies	% of total
Full independent/ autonomous company	138	62.2
Operates as independent/ autonomous company, although part of larger group	65	29.3
Effectively under the control of a larger group	19	8.6

(n=222)

Nearly two-thirds of all companies (Table 5.6, n=222) manufactured products sold under a retailers own label. This illustrates the degree of involvement the large retailers have with manufacturers in the U.K. More than half of all companies (Table 5.7, n=222) stated that since October 1983 their company's products had been specifically promoted and marketed at the "healthy eating" segment. This perhaps suggests a conscious effort by manufacturers to cater for the consumer as far as "healthy eating" is concerned in an area of generally very traditional product ranges, although it must be borne in mind that many companies taking part in the survey make products other than those using sugar as an important ingredient and they could be referring to these. However, it still gives an indication of the impact of "healthy eating" on food manufacturing. In later sections this area of response will be considered in more detail with the results producing some interesting suggestions.

Claims on products also proved very popular for respondents. These had been made by 186 companies (Table 5.8) and the most popular claims were in the areas associated with "artificial ingredients". More than half the companies had used these sort of claims; 92 had claimed "no additives", 125 "no artificial flavouring", 85 no "artificial colourings and 98 "no preservatives". Again, it must be remembered that these claims do not necessarily refer to products that use sugar, but still serve as an indication of marketing activity in respect of "healthy eating", particularly as far as food additives are concerned.

The other surprising use of claims, considering the product categories manufactured by responding companies, were those in relation to sugar. The claim "no added sugar" was used by 43 companies. The other "sugar" claims had been quite well used which perhaps reflects recent changes in the soft drinks market and the promotion of low calorie drinks, it is also indicative that

some manufacturers consider it worthwhile to "knock" sugar or point out the apparent absence of sugar in certain market segments even if a company manufactures sugar-full products as well. A variety of other claims were used by respondents and these are listed in Table 5.9.

TABLE 5.6

COMPANIES MANUFACTURING PRODUCTS SOLD UNDER A RETAILERS' OWN LABEL

	No. Companies	% of total
"Yes"	150	67
"No"	74	33
(n=224)		

TABLE 5.7

COMPANIES PROMOTING AND MARKETING PRODUCTS AIMED AT THE "HEALTHY EATING" SEGMENT

	No. Companies	% of total
"Yes"	117	52.7
"No"	105	47.3
(n=222)		

TABLE 5.8

CLAIMS MADE BY RESPONDING COMPANIES ON THEIR PRODUCTS

Claim	"YES"
no sugar	23
sugar free	39
sugar reduced	24
no added sugar	43
no additives	92
low calorie	56
no preservatives	98
no artificial flavourings	125
no artificial colourings	85
high fibre	40
contains artificial sweetener	16
none of these	38

(n=224)

TABLE 5.9

OTHER PRODUCT CLAIMS MENTIONED AS USED BY RESPONDING COMPANIES

Claim	No. Companies mentioning using claim
Natural ingredients	2
No MSG	1
No cholesterol	1
Organically grown	1
High in polyunsaturates	1
Hand made items	1
Gluten free	2
Full nutrition values	1
No animal fats	2
Lower fat	4
No artificial sweeteners	1
Diet drink	1
Raw sugar	2
Low fat	1
Vegetarian Society approved	1

5.3.2.2 Sugar and sweeteners purchased by respondent companies

The total industrial market for sucrose in 1985/86 was around 1,500,000 tonnes white sugar equivalents. From the survey, 164 companies answered Question 7 for sucrose bought in 1986. This proved the most sensitive question of the survey with many companies preferring not to reveal their purchases. Of those who did answer, the total amount of sucrose bought added up to 505,182 tonnes, individual quantities ranging from 1 tonne to more than 70,000 tonnes. Using the tonnage bought by companies answering Question 7 and matching them to other similar companies who left Question 7 blank the estimate for total sucrose bought by respondents is between 650,000 and 700,000 tonnes or 43%-47% of the total industrial sugar bought in 1986. The quantities for sucrose and other sweeteners are listed in Table 5.10. While all the companies included in the analysis used sucrose as an ingredient, only a selection of companies would use other sweeteners as well. The figures for bulk sweeteners are not included, although some respondents used these, because a printers error on some questionnaires has meant there could be some confusion over respondent replies to this question.

5.4 Statistical Description and Discussion of the Attitudinal Statements on Sugar, Diet and Health

5.4.1 Use of sugar by responding companies

(Note: Tables 5.11-5.34 mentioned in this section are included at the end of the text for ease of reference.)

Sugar is used in the food and drink products manufactured by responding companies for a combination of its technical properties (Table 5.11, 91.8% agreeing), although taste is ranked as the most important reason why a responding company uses sugar by 72.1% (Table 5.12), so "sweetness" per se is the overiding feature for the products of nearly two-thirds of responding

TABLE 5.10

SUGAR AND SWEETENERS BOUGHT BY RESPONDING COMPANIES

Sugar/Sweetener	tonnes	No. Companies giving figures	Comparison with total industrial market (%)
Sucrose	505,182	164	33.7
Isoglucose	2,803	9	7.6
Glucose Syrups	164,409	85	43.1
Other Sugars	41,267	54	n/a
Aspartame	15	14	10.7
Saccharin	55	40	10.3
Acesulfame	-	-	-
Thaumatin	-	-	-

(n=164)

(Note: For what it is worth, as it is not certain how valid the figures are, by matching respondents to the profile of industrial customers given in Table 5.1, the total U.K. market share of respondents was a little over 54%.)

companies confirming that the sample is dominated by manufacturers of "sweet" products rather than just products that use sugar solely for technical reasons. With this in mind, two-thirds of respondents still agreed it was "technically" possible to reduce some of the sucrose in their company's products (Table 5.13) which adds weight to the BNF's Sugars Task Force's calculation that a large proportion of sugar could be removed from industrial use (see Chapter Four and BNF, 1987).

5.4.2 Responding companies general perceptions about sugar, diet and health

One in ten of respondents working for companies that use sugar in food and drink manufacture, did not agree sugar is a natural part of a balanced diet (Table 5.14). This statement was included as a positive, topic-related opener for Section Two and it was not anticipated that many respondents would disagree with it.

Tables 5.15 to 5.20 examine the more general attitudes of manufacturers to diet. The responses to these statements clearly demonstrate awareness of the diet and health issue by manufacturers, but responsibility for a balanced diet was considered as the individual consumer's concern, (Table 5.15) with 86.6% agreeing that it is up to the individual to think about whether they are getting a balanced diet. It is interesting to contrast the response to this statement to the strong agreement among respondents that consumers are confused about what is and what is not a healthy and balanced diet, with 96.9% agreeing this is the case (Table 5.16). It is up to the individual to sort out their diet but they are not doing very well in the eyes of the food manufacturer!

A large majority of respondents agreed (88.8%, Table 5.17) that the "healthy eating" lifestyle is here to stay and, in particular, more than three-quarters (77.8%, Table 5.18) agreed they were fully aware of the dietary

recommendations that talk about average sugar consumption, with just under half the sample either completely or strongly agreeing with this statement. It was unexpected, however, that more than a third of respondents (37.4%, Table 5.19) would agree that cutting average U.K. sugar consumption by half (as suggested by NACNE, 1983) is a realistic target, although of those who disagreed 42.9% either strongly or completely disagreed.

The awareness of diet as an issue was very positive by respondents with large majorities believing "healthy eating" is here to stay (Table 5.17) and knowing about dietary recommendations relating to sucrose eating (Table 5.18). It was another large majority (80.3%, Table 5.20) that agreed that a small reduction in average sucrose consumption would be better for the nations's health, but it will be noticed that in the main agreement was 'mild'.

5.4.3 Responding companies attitudes to consumer behaviour

The next series of statements (Tables 5.21 to 5.26) examine companies attitudes to how the consumer may or may not be responding to dietary advice as far as sugar is concerned and how consumers regard sugar. It was anticipated that a large majority (86.7%, Table 5.21) would agree that a small number of consumers are worried sugar might be bad for their health, with more than 60% completely or strongly agreeing - this has probably always been the case.

More serious for a manufacturer with a product range that is either completely or in key areas dependent on sugar is the belief that a majority of consumers may consider one of their major ingredients to be bad for health. Among respondents a little under two-thirds (60.3%, Table 5.22) agreed that a majority of consumers are worried sugar might be bad for their health. However, consumers may be worried about sugar eating, in relation to their health, but this may not necessarily reflect itself in buying actions. This

difference in belief and behaviour by consumers is suggested by the fact that responding companies were almost equally split (Table 5.23) over whether consumers were interested in their individual sugar consumption, with 47% agreeing consumers were not interested and 53% that they were.

This ambivalence over beliefs and actual behaviour is also reflected in the split between respondents over whether the majority of consumers are actively trying to cut down on their individual sugar intakes (Table 5.24). 56.7% agreed consumers are, albeit, in the main, only mildly agreeing. The interesting point from the responses to these statements is that the majority of responding companies, although only mildly, agreed that the consumer <u>is</u> worried sugar is bad for their health, the consumer <u>is</u> interested in their individual sugar intakes and the majority <u>is</u> trying to cut back on sugar consumption. Perhaps it is fair to speculate that a few years ago the 'agreement' or 'disagreement' to these statement would be reversed.

Finally, is this state of affairs permanent or transient? Responding companies were split over whether cutting back on sugar consumption is just another eating fad, with those agreeing that it was (55.2%, Table 5.25) having the edge. However, the changes in consumer attitudes, as perceived by responding companies, is borne out strikingly with nearly three-quarters disagreeing that current concerns about diet, sugar and health will make no difference to average sugar consumption in the long-run, they clearly feel it will (Table 5.26).

5.4.4 Changes being made by responding companies

Tables 5.27 and 5.34 explore in more detail changes responding companies have made to apparent consumer attitudes on sugar and diet. Respondents disagreed that consumer attitudes towards sugar had encouraged their companies to develop products using alternative sweeteners (59.7%,

Table 5.27), with nearly a third (30.1%) completely disagreeing with the statement. However, a majority of respondents (60.7%, Table 5.28) agreed that it was now worthwhile exploring the manufacture of products using sweeteners other than sucrose. This may have nothing to do with consumer attitudes towards sucrose, but rather manufacturers looking for new products and new market niches. This could be the result of a greater choice of newly approved or developing sucrose substitutes, whether they are high intensity, "bulk" sweeteners or new bulking agents.

The next series of Tables (Table 5.29-5.34) show a degree of mixed opinion among respondents. This may be due to the size of responding company, range of products or lack of resources to address the issue. Respondents were split over whether consumers making changes to their diet in recent years, had resulted in lower sales of some of their company's products (not necessarily products with sugar). A little over half (50.7%, Table 5.29) agreed with this statement.

A little under half (48.2%, Table 5.30) agreed consumer views on "healthy eating" had played only a small part if any in their company's marketing strategies to date. It will be remembered that nearly 90% agreed that the "healthy eating" lifestyle is here to stay. This could reflect the difficulty many companies have in responding to this consumer change or the irrelevance of "healthy eating". For example, if a company's main business is to supply products for a retailers' own label they may have little say in its final marketing. Of course another way to consider the response to this statement is that more than half of the companies in the survey had actually considered consumer views and responded positively to the new opportunities offered by a "healthy eating" market.

Whereas respondents only narrowly felt consumer views on diet in general had resulted in lower sales of some products, consumer attitudes to

sugar itself had not had quite the same impact and 57% (Table 5.31) disagreed, 37.9% strongly or completely disagreeing, that consumer attitudes to sugar had resulted in lower sales of some of their company's products.

While consumer attitudes to sugar are important for the companies responding to the survey, they are not that important. There was nearly total agreement (91.9%, Table 5.32), with just under half completely agreeing; "that factors other than consumer attitudes to sugar are more important to the success of their company". Although other factors are important, it is acknowledged that the sugar, diet and health debate is relevant to a responding company's success. Just under two-thirds disagreed (63.9%, Table 5.33) that this subject is of little or no relevance to their company's success. Finally, on the, speculative statement about the market size of sugar-reduced or sugar-free products, 71.7% (Table 5.34) agreed these would always be a small segment of the total market in which their company sold.

5.4.5 Summary

The food and drink manufacturers that responded to the survey are very aware of the sugar, diet and health issue and agree that a small reduction in sucrose consumption would be better for the nation's health. They also believe a majority of consumers are not only concerned about sugar being bad for their health, but are actively trying to reduce their individual sugar consumption. A worrying state of affairs from the sugar producers and manufacturers point of view.

However, although the sugar, diet and health issue is relevant to responding companies success, is the issue regarded as transient rather than permanent? Other factors are more important to a company's long-term success, the sugar-reduced and sugar-free market segment will always be a small segment of the total market, cutting back on sugar is - just - another

eating fad and consumers are confused about what is and what is not a healthy and balanced diet of which sugar is a natural part. Despite or in spite of this, most respondents believe that current consumer views on sugar will have an impact on average sugar consumption in the long-run. Since consumer views tend to be negative towards sugar this may be interpreted as suggesting that respondents believe average consumption will fall.

The general message from respondents is that the issue is still being decided. In other words, is all the fuss about sugar a passing "fad", to be taken seriously, but nevertheless not an issue of lasting concern? Or will consumers tend towards permanent reduced sugar consumption? The next two sections consider respondents replies in more detail to see if they give more clues to answer these questions.

TABLE 5.11 SUGAR IS USED BY MY COMPANY FOR A COMBINATION OF ITS TECHNICAL PROPERTIES

	No. Companies	%	Agree/Disagree
I completely agree	114	52.1)	
I strongly agree	53	24.2)	91.8
I mildly agree	34	15.5)	
I mildly disagree	7	3.2)	
I strongly disagree	6	2.7)	8.2
I completely disagree	5	2.3)	

n=219 mean=1.872

TABLE 5.12 TASTE IS THE MOST IMPORTANT REASON WHY MY COMPANY USES SUGAR AS AN INGREDIENT

	No. Companies	%	Agree/Disagree
I completely agree	69	31.5)	
I strongly agree	43	19.6)	72.1
I mildly agree	46	21.0)	
I mildly disagree	24	11.0)	
I strongly disagree	17	7.8)	27.9
I completely disagree	20	9.1)	

n=219 mean=2.712

TABLE 5.13 IT IS "TECHNICALLY" POSSIBLE TO REDUCE SOME OF THE SUCROSE IN MY COMPANY'S PRODUCTS

	No. Companies	%	Agree/Disagree
I completely agree	50	23.1)	
I strongly agree	38	17.6)	67.6
I mildly agree	58	26.9)	
I mildly disagree	20	9.3)	
I strongly disagree	24	11.1)	32.4
I completely disagree	26	12.0)	

n=216 mean= 3.037

TABLE 5.14 SUGAR IS A NATURAL PART OF A BALANCED DIET

	No. Companies	%	Agree/Disagree
I completely agree	92	41.3)	
I strongly agree	43	19.3)	89.7
I mildly agree	65	29.1)	
I mildy disagree	14	6.3)	
I strongly disagree	6	2.7)	10.3
I completely disagree	3	1.3)	

n=223 mean =2.139

TABLE 5.15 IT IS UP TO THE INDIVIDUAL TO THINK ABOUT WHETHER THEY ARE GETTING A BALANCED DIET

	No. Companies	%	Agree/Disagree
I completely agree	86	38.4)	
I strongly agree	60	26.8)	86.6
I mildly agree	48	21.4)	
I mildly disagree	24	10.7)	
I strongly disagree	4	1.8)	13.4
I completely disagree	2	0.9)	

n=224 mean=2.134

TABLE 5.16 CONSUMERS ARE CONFUSED ABOUT WHAT IS AND WHAT IS NOT A HEALTHY AND BALANCED DIET

	No. Companies	%	Agree/Disagree
I completely agree	109	48.9)	
I strongly agree	68	30.5)	96.9
I mildly agree	39	17.5)	
I mildly disagree	4	1.8)	
I strongly disagree	3	1.3)	3.1
I completely disagree	0	0.0)	

n=224 mean=1.762

TABLE 5.17 THE "HEALTHY EATING" LIFESTYLE IS HERE TO STAY

	No. Companies	%	Agree/Disagree
I completely agree	64	28.7)	
I strongly agree	57	25.6)	88.8
I mildly agree	77	34.5)	
I mildly disagree	18	8.1)	
I strongly disagree	3	1.3)	11.2
I completely disagree	4	1.8)	

n=223 mean=2.332

TABLE 5.18 MY COMPANY IS FULLY AWARE OF THE DIETARY RECOMMENDATIONS THAT TALK ABOUT AVERAGE SUCROSE CONSUMPTION

	No. Companies	%	Agree/Disagree
I completely agree	58	26.4)	
I strongly agree	49	22.3)	77.8
I mildly agree	64	29.1)	
I mildly disagree	35	15.9)	
I strongly disagree	8	3.6)	22.2
I completely disagree	6	2.7)	

n=220 mean =2.564

TABLE 5.19 THE RECOMMENDATION BY SOME HEALTH EXPERTS THAT AVERAGE UK SUGAR CONSUMPTION SHOULD BE CUT BY HALF IS A REALISTIC TARGET

	No. Companies	%	Agree/Disagree
I completely agree	17	7.8)	
I strongly agree	13	5.9)	37.4
I mildly agree	52	23.7)	
I mildly disagree	43	19.6)	
I strongly disagree	57	26.0)	62.6
I completely disagree	37	16.9)	

n=219 mean=4.009

TABLE 5.20 A SMALL REDUCTION IN AVERAGE SUCROSE CONSUMPTION WOULD BE BETTER FOR THE NATION'S HEALTH

	No. Companies	%	Agree/Disagree
I completely agree	47	21.0)	
I strongly agree	33	14.7)	80.3
I mildly agree	100	44.6)	
I mildly disagree	28	12.5)	
I strongly disagree	7	3.1)	19.7
I completely disagree	9	4.0)	

n=224 mean=2.741

TABLE 5.21 A SMALL NUMBER OF CONSUMERS ARE WORRIED SUGAR MIGHT BE BAD FOR THEIR HEALTH

	No. Companies	%	Agree/Disagree
I completely agree	83	37.1)	
I strongly agree	60	26.8)	86.7
I mildly agree	51	22.8)	
I mildly disagree	15	6.7)	
I strongly disagree	10	4.5)	13.3
I completely disagree	5	2.2)	

n=224 mean=2.214

TABLE 5.22 THE MAJORITY OF CONSUMERS ARE WORRIED SUGAR MIGHT BE BAD FOR THEIR HEALTH

	No. Companies	%	Agree/Disagree
I completely agree	17	7.6)	
I strongly agree	32	14.3)	60.3
I mildly agree	86	38.4)	
I mildly disagree	56	25.0)	
I strongly disagree	20	8.9)	39.7
I completely disagree	13	5.8)	

n = 224 mean = 3.308

TABLE 5.23 CONSUMERS ARE NOT VERY INTERESTED IN THEIR INDIVIDUAL SUGAR CONSUMPTION

	No. Companies	%	Agree/Disagree
I completely agree	13	5.8)	
I strongly agree	19	8.5)	47
I mildly agree	73	32.7)	
I mildly disagree	71	31.8)	
I strongly disagree	41	18.5)	53
I completely disagree	6	2.7)	

n=223 mean=3.565

TABLE 5.24 THE MAJORITY OF CONSUMERS ARE ACTIVELY TRYING TO CUT DOWN ON THEIR INDIVIDUAL SUGAR INTAKES

	No. Companies	%	Agree/Disagree
I completely agree	8	3.6)	
I strongly agree	20	9.0)	56.7
I mildly agree	98	44.1)	
I mildly disagree	50	22.5)	
I strongly disagree	33	14.9)	43.3
I completely disagree	13	5.9)	

n=222 mean=3.536

TABLE 5.25 CUTTING BACK ON SUGAR CONSUMPTION BY CONSUMERS IS JUST ANOTHER EATING FAD

	No. Companies	%	Agree/Disagree
I completely agree	25	11.2)	
I strongly agree	30	13.5)	55.2
I mildly agree	68	30.5)	
I mildly disagree	50	22.4)	
I strongly disagree	35	15.7))	44.8
I completely disagree	15	6.7)	

n=223 mean=3.381

TABLE 5.26 CURRENT CONSUMER CONCERNS ABOUT DIET AND HEALTH WILL MAKE NO DIFFERENCE WHATSOEVER TO AVERAGE SUGAR CONSUMPTION IN THE LONG RUN

	No. Companies	%	Agree/Disagree
I completely agree	11	4.9)	
I strongly agree	13	5.8)	27.3
I mildly agree	37	16.6)	
I mildly disagree	96	43.0)	
I strongly disagree	46	20.6)	72.7
I completely disagree	20	9.0)	

n=223 mean=3.955

TABLE 5.27 CONSUMER ATTITUDES TOWARDS SUCROSE HAVE ENCOURAGED MY COMPANY TO DEVELOP PRODUCTS USING ALTERNATIVE SWEETENERS

	No. Companies	%	Agree/Disagree
I completely agree	27	12.5)	
I strongly agree	14	6.5)	40.3
I mildly agree	46	21.3)	
I mildly disagree	44	20.4)	
I strongly disagree	20	9.3)	59.7
I completely disagree	65	30.1)	

n=216 mean=3.977

TABLE 5.28 MY COMPANY NOW CONSIDERS IT WORTHWHILE TO EXPLORE MANUFACTURING PRODUCTS USING SWEETENERS OTHER THAN SUCROSE

	No. Companies	%	Agree/Disagree
I completely agree	35	16.0)	
I strongly agree	32	14.6)	60.7
I mildly agree	66	30.1)	
I mildly disagree	32	14.6)	
I strongly disagree	24	11.0)	39.3
I completely disagree	30	13.7)	

n=219 mean =3.311

TABLE 5.29 CONSUMERS MAKING CHANGES TO THEIR DIET IN RECENT YEARS HAS RESULTED IN LOWER SALES OF SOME OF MY COMPANY'S PRODUCTS

	No. Companies	%	Agree/Disagree
I completely agree	25	11.3)	
I strongly agree	17	7.7)	50.7
I mildly agree	70	31.7)	
I mildly disagree	33	14.9)	
I strongly disagree	32	14.5)	49.3
I completely disagree	44	19.9)	

n=221 mean=3.733

TABLE 5.30 CONSUMER VIEWS ON "HEALTHY EATING" HAVE PLAYED ONLY A SMALL PART, IF ANY, IN MY COMPANY'S MARKETING STRATEGIES TO DATE

	No. Companies	%	Agree/Disagree
I completely agree	30	13.5)	
I strongly agree	40	18.0)	48.2
I mildly agree	37	16.7)	
I mildly disagree	36	16.2)	
I strongly disagree	43	19.4)	51.8
I completely disagree	36	16.2)	

n=222 mean=3.586

TABLE 5.31 CONSUMER ATTITUDES TO SUGAR HAVE RESULTED IN LOWER SALES OF SOME OF MY COMPANY'S PRODUCTS

	No. Companies	%	Agree/Disagree
I completely agree	19	8.7)	
I strongly agree	12	5.5)	43
I mildly agree	63	28.8)	
I mildly disagree	42	19.2)	
I strongly disagree	41	18.7)	57
I completely disagree	42	19.2)	

n=219 mean=3.913

TABLE 5.32 FACTORS OTHER THAN CONSUMER ATTITUDES TO SUGAR ARE MORE IMPORTANT TO THE SUCCESS OF MY COMPANY

	No. Companies	%	Agree/Disagree
I completely agree	108	48.6)	
I strongly agree	67	30.2)	91.9
I mildly agree	29	13.1)	
I mildly disagree	15	6.8)	
I strongly disagree	3	1.3)	8.1
I completely disagree	0	0.0)	

n=222 mean=1.820

TABLE 5.33 IN THE LONG RUN THE SUGAR, DIET AND HEALTH DEBATE IS OF LITTLE OR NO RELEVANCE TO MY COMPANY'S SUCCESS

	No. Companies	%	Agree/Disagree
I completely agree	17	7.7)	
I strongly agree	29	13.1)	36.1
I mildly agree	34	15.3)	
I mildly disagree	65	29.3)	
I strongly disagree	39	17.6)	63.9
I completely disagree	38	17.1)	

n=224 mean=3.874

TABLE 5.34 SUGAR-REDUCED OR SUGAR-FREE PRODUCTS WILL ALWAYS BE A SMALL SEGMENT OF THE TOTAL MARKET IN WHICH MY COMPANY SELLS

	No. Companies	%	Agree/Disagree
I completely agree	56	25.6)	
I strongly agree	44	20.1)	71.7
I mildly agree	57	26.0)	
I mildly disagree	24	11.0)	
I strongly disagree	19	8.7)	28.3
I completely disagree	19	8.7)	

n=219 mean=2.831

5.5 A Factor Analysis on the 1988 National Survey of Sugar and Sweetener Users

A factor analysis was used on the twenty-four attitudinal statements dealing with the issue of sugar, diet and health (Section Two of the questionnaire). The purpose of the analysis was to investigate how variables related to each other enabling further insight on the results of the descriptive analysis.

The goals of a factor analysis are:

1. To identify underlying constructs or "factors" that explain the correlations among a set of variables.
2. To test hypotheses about the structure of variables.
3. To summarize a large number of variables with smaller number of "derived" variables.

The identification of such underlying dimensions or factors can greatly simplify the description and understanding of complex phenomena, in this case the attitudes of food and drink manufacturers to the issue of sugar, diet and health. A factor analysis, therefore, is a statistical technique used to identify a relatively small number of factors that can be used to represent relationships among sets of many interrelated variables (Norusis, 1985; Anastasi, 1983).

To help with the interpretation of a factor analysis the factor matrix is "rotated". This rotation phase of a factor analysis attempts to transform the initial factor matrix into one that is easier to interpret. The varimax method was used to produce a rotated factor analysis. This method attempts to minimise the number of variables that have high loadings on a factor.

To decide how many "factors" are needed to represent the data, it is helpful to examine the percentage of total variance explained by each. The variance explained by each factor is expressed as an eigenvalue (the

eigenvalue being the ratio of the between-groups to within-groups sums of squares). Large eigenvalues are associated with "good" functions. Eigenvalues greater than one were used to determine the "good" factors of the Survey data.

Four factors were identified using this method which accounted for 73.5% of the total variance between variables (Table 5.35).

TABLE 5.35

EIGENVALUES AND VARIANCE FOR FACTORS 1-4

Factor	Eigenvalue	% of variance	cumulative %
1	4.09	35.5	35.5
2	2.10	18.3	53.8
3	1.24	10.9	64.6
4	1.02	8.9	73.5

These factors (1 to 4) with the statistically significant attitudinal statements (factor correlations > 0.4) are:

Factor One

+ Sugar is a natural part of a balanced diet
+ Sugar is used by my company for a combination of its technical properties
- The recommendation by some health experts that average U.K. sugar consumption should be cut by half is a realistic target

Factor Two

+ Consumers making changes to their diet in recent years has resulted in lower sales of some of my company's products
+ Consumer attitudes to sugar have resulted in lower sales of some of my company's products

Factor Three

- Consumers are not very interested in their individual sugar consumption
+ The majority of consumers are worried sugar might be bad for their health
+ The majority of consumers are actively trying to cut down on their individual sugar intakes

Factor Four

+ Consumer attitudes towards sugar have encouraged my company to develop products using alternative sweeteners
+ My company now considers it worthwhile to explore manufacturing products using sweeteners other than sucrose

The factor analysis suggests the power of the consumer on food and drink manufacturers. Factor One, "Sugar: The Optimum Sweetener" clearly puts sugar as a functional ingredient and natural food in the diet, with advice about cutting average sugar consumption by half being completely unrealistic.

However, Factor Two "The Lost Sales Factor" suggests that not only have consumers been making changes to their diet in recent years resulted in lower sales, but sugar alone has also acted as a negative buying attribute contributing to lost sales of sugar containing foods.

This is reinforced by Factor Three "The Majority Consumer Factor" which confirms that respondents consider consumers to be interested not only in their individual consumption, but the majority of consumers are actually worried sugar is bad for their health and are actively cutting down on sugar intakes.

To some extent the food and drink manufacturers response to this belief

is illustrated in Factor Four "The Alternative Sweetener Factor" which suggests that some responding companies have taken or are taking into consideration the use of alternative sweeteners to sucrose into their product ranges (see Chapter Six for a further discussion of the results from the Factor Analysis).

5.6 Univariate and Multivariate Discriminant Analysis

5.6.1 Introduction

A discriminant analysis is a technique which statistically makes it possible to distinguish between two or more groups of cases and if such a difference exists. To do this a selection of discriminating variables are used that measure characteristics on which the groups are expected to differ. The aims of a discriminant analysis are:

1. To classify cases into one of several mutually exclusive groups on the basis of various characteristics.
2. To establish which characteristics are important for distinguishing among the groups.
3. To evaluate the accuracy of the classification (Norusis, 1985; Klecka, 1980; Tabachnick and Fidell, 1983).

Six discriminant analyses were carried out comparing the following groups of cases. These were:

1. Small companies v. large companies.
2. Medium companies v. large companies.
3. Small and medium companies v. large companies.
4. Medium companies v. small companies.
5. Companies answering "YES" to the question: "Does your company manufacture products sold under retailer's own label" v. companies answering "NO".
6. Companies answering "YES" to the question: "Since October 1983 have

any of your company's products, including any own label products, been specifically promoted and marketed of the "healthy eating segment" v. companies that anwered "NO".

The discriminating variables used were the attitudinal statements on sugar, diet and health and a number of other variables. For each group of cases analysed a univariate analysis was performed first using an one way analysis of variance before following on with the multivariate discriminant analysis.

(Note: The scores for the attitudinal statements ranged from: 1 = "I completely agree" to 6 = "I completely disagree", for other variables "yes" = 1 and "no" = 0. A total of 38 variables were used in the analysis to distinguish between companies based on annual turnover, and 37 for the last two.)

5.6.2 Univariate and multivariate analysis between small companies and large companies

5.6.2.1 Univariate analysis

From the univariate analysis (Table 5.36) six variables ($p \leq 0.05$) significantly discriminated between large and small companies. Importantly, large companies tended to disagree more than small companies that cutting back on sugar consumption by consumers is just another eating fad. Large companies were also more likely to agree that it is possible to reduce sucrose in their products and, although both small and large companies agreed, 'other factors' were more important to a large company's success than small companies. More large companies manufactured own label products for retailers and had promoted and marketed products aimed at the "healthy eating" segment than small companies. Small companies, in comparison to large companies, had not used the "claims" listed in the questionnaire.

TABLE 5.36

UNIVARIATE ANALYSIS OF VARIANCE COMPARING SMALL AND LARGE COMPANIES DEFINED BY ANNUAL TURNOVER

	Variable	mean x 1=small co. 2=large co.	F-value	Significance ($p \leq 0.05$)
1)	Cutting back on sugar consumption by consumers is just another eating fad	1. = 3.23 2. = 3.66	4.027	0.047
2)	It is "technically" possible to reduce some of the sucrose in my company's products	1. = 3.68 2. = 2.91	5.617	0.019
3)	Factors other than consumer attitudes to sugar are more important to the success of my company	1. = 2.13 2. = 1.61	6.091	0.015
4)	Does your company manufacture products sold under a retailer's own label	1. = 0.52 2. = 0.88	25.70	0.00001
5)	Since October 1983 have any of your company's products been specifically promoted and marketed of the "healthy eating" segment	1. = 0.48 2. = 0.81	5.908	0.016
6)	Claims: "none of these"	1. = 0.52 2. = 0.09	4.486	0.036

1. small company, n=88
2. large company, n=67

5.6.2.2 Multivariate analysis

The results from a discriminant function analysis show that the interaction of the 20 variables listed (Table 5.37) significantly discriminates between small and large companies when defined by turnover. (Canonical correlation = 0.70; Note: the canonical correlation is a measure of the degree of association between the discriminant scores and the groups, i.e. the higher the correlation, the less the association between groups.)

When used to predict group membership of responding companies, for small companies the overall classification rate was 87.5%, that is 77 out of the 88 companies defined as small, and for large companies the overall classification rate was 83.6%, that is 56 out of 67 companies defined as small. The percentage of grouped companies being correctly classified (Table 5.38) using the interative variables in Table 5.37 was 85.81%. The questionnaire has a very good predictative value for the different responding companies.

TABLE 5.38

CLASSIFICATION RESULTS FOR SMALL AND LARGE COMPANIES

Actual Group	No. Cases	Predicted Group Membership 1	2
Small company	88	77 87.5%	11 12.5%
Large company	67	11 16.4%	56 83.6%

Percentage of grouped cases correctly classified = 85.81%

(Note: On the interpretation of Standardized Canonical Discriminant Function coefficients: A small or large company can be predicted from the sum of the

TABLE 5.37

STANDARDIZED CANONICAL DISCRIMINANT FUNCTIONS COEFFICIENTS

(Large and Small Companies)

Abbreviated Variables		Function 1
1.	Sugar natural part balanced diet .	0.28217
2.	Small number consumers worried sugar bad for health	0.23734
3.	Consumer attitudes encouraged use alternative sweeteners	0.26790
4.	Taste most important reason company uses sugar	-0.30550
5.	Consumers confused about healthy and balanced diet	0.23558
6.	"Technically" possible reduce sucrose in products	-0.28846
7.	Reduction by half is realistic target	0.32325
8.	Up to individual think about balanced diet	0.51886
9.	Small reductions average sucrose consumption better health	0.30602
10.	Company fully aware dietary recommendations	-0.47224
11.	Factors other than sucrose consumption	-0.50704
12.	Majority consumers cutting down on sugar intakes	0.25428
13.	Current concern no difference long-run sugar consumption	0.34699
14.	In long-run debate not relevant company's success	0.15858
15.	Company manufacturing for retailer's own label	0.78631
16.	Claims: "no sugar"	0.59552
17.	"sugar free"	-0.65664
18.	"sugar reduced"	1.18750
19.	"low calorie"	1.23704
20.	"none of these"	-1.43172

Canonical Discriminant Functions Evaluated of Groups Means (Group Centroids)

Small company -0.85441
Large company 1.12221

scores of the function coefficients. For example, if a company answers "I mildly disagree" to the statement "Sugar is a natural part of a balanced diet", they score 4. This is then multiplied by the function coefficient, in this case, 0.28217. This is repeated for all 20 variables and the total calculated. The total is then compared to the Group Centroids. If the total is less than -0.85441 the company is likely to be a small company, if greater than 1.12221, a large company, since the predictability of the combination of variables = 85.81%. In between these totals will fall "unclassified" companies.)

5.6.3 Univariate and multivariate analysis between medium companies and large companies

5.6.3.1 Univariate analysis

Six variables are statistically significant ($p \leq 0.05$) when company responses to the questionnaire between medium and large companies (Table 5.39) are compared. Medium companies are less likely to use sugar for a combination of its technical properties than large companies. Large companies were more inclined to agree that consumers making changes to their diets had resulted in lower sales and to disagree that consumers are not very interested in their individual sugar consumption than medium-sized companies. Large companies also believe the sugar, diet and health debate is more relevant to their company's success than medium companies. More large companies sold products under a retailer's own label and had promoted products aimed at the "healthy eating" segment.

TABLE 5.39

UNIVARIATE ANALYSIS OF VARIANCE BETWEEN MEDIUM COMPANIES AND LARGE COMPANIES AS DEFINED BY ANNUAL TURNOVER

	Variable	mean	1=small co. 2=large co.	F-value	Significance ($p \leq 0.05$)
1.	Sugar is used by my company for a combination of its technical properties	1. = 2.42 2. = 1.90		3.962	0.049
2.	Consumers making changes to their diet in recent years has resulted in lower sales of some of my company's products	1. = 4.15 2. = 3.45		5.802	0.017
3.	Consumers are not very interested in their individual sugar consumption	1. = 3.88 2. = 3.48		4.439	0.037
4.	In the long-run the sugar, diet and health debate is of little or no relevance to my company's success	1. = 3.52 2. = 4.27		8.267	0.0051
5.	Company manufactures products sold under retailer's own label	1. = 0.66 2. = 0.88		10.01	0.002
6.	Products promoted as "healthy eating" segment	1. x = 0.46 2. x = 0.81		17.89	0.00

1. medium company, n=67
2. large company, n=67

5.6.3.2 Multivariate analysis

The results from a discriminant function analysis show that the interaction of the 18 variables listed (Table 5.40) significantly discriminates between medium-sized and large companies when defined by turnover (canonical correlation = 0.66).

When used to predict group membership of responding companies, for medium-sized companies the correct classification rate was 80.6%, that is 54 out of 67 companies. For large companies the correct classification rate was again 80.6%, 54 out of 67 companies (Table 5.41). The percentage of grouped companies being correctly classified, therefore, using the interactive variables listed in Table 5.40 was 80.6%.

TABLE 5.41

CLASSIFICATION RESULTS FOR MEDIUM AND LARGE COMPANIES

Actual Group	No. Cases	Predicted Group Membership 1	2
Medium company	67	54 80.6%	13 19.3%
Large company	67	13 19.4%	54 80.6%

Percentage of grouped cases correctly classified = 80.6%

TABLE 5.40

STANDARDIZED CANONICAL DISCRIMINANT FUNCTIONS COEFFICIENTS

(MEDIUM AND LARGE COMPANIES)

Variables (abbreviated)		Function 1
1.	Sugar is a natural part of a balanced diet	0.21779
2.	A small number of consumers worried sugar might be bad for health	0.29760
3.	Consumer attitudes encouraged use alternative sweeteners	0.58043
4.	Lower sales of some of company products	-0.26964
5.	Consumers not interested in individual sugar consumption	-0.37120
6.	"Technically" possible reduce sucrose in products	0.25698
7.	Up to individual think about balanced diet	-0.21763
8.	Factors other than sucrose consumption	-0.36024
9.	In long-run debate not relevant company's success	0.40925
10.	Explore manufacturing products other sweeteners	-0.42013
11.	Company manufactures for retailers own label	0.41991
12.	Promoting products "healthy eating" segment	0.43104
13.	Claims "sugar reduced"	0.81810
14.	"low calorie"	0.62934
15.	"no preservatives"	-0.33432
16.	"no artificial flavourings"	-0.32947
17.	"high fibre"	-0.48652
18.	"none of these"	-0.43386

Canonical discriminant functions estimated at group means (Group Centroids)

1.	Medium companies	-0.87076
2.	Large companies	0.87076

5.6.4 Univariate and multivariate analysis between small plus medium companies and large companies

5.6.4.1 Univariate analysis

Five variables are statistically significant when comparing small and medium companies combined to large companies (Table 5.42). Of these only three were on attitudes. Large companies had a significantly larger annual turnover and were more likely to answer "yes" to manufacturing products sold under a retailer's own label. Large companies had seen lower sales of some of their products due to consumers making changes in their diet than small and medium companies. They also considered other factors to be more important to their company's success than consumer attitudes to sugar compared to medium and small companies. The latter, however, felt less strongly that, in the long-run, the sugar, diet and health debate is of little or no relevance to their company's success than large companies.

5.6.4.2 Multivariate analysis

The results from a discriminant function analysis show that the interactions of the 21 variables listed in Table 5.43 significantly discriminates between small and medium companies combined and large companies when defined by turnover. (Canonical correlation = 0.58.)

When used to predict group membership of responding companies, for the small and medium companies considered, the classification rate was 78.7% or 122 out of 155 companies. For large companies the classification rate was 79.1% or 53 out of 67 companies (Table 5.44). The percent of grouped cases correctly classified was 78.83%.

TABLE 5.42

UNIVARIATE ANALYSIS OF VARIANCE BETWEEN SMALL AND MEDIUM COMPANIES TO LARGE COMPANIES AS DEFINED BY ANNUAL TURNOVER

	Variable	mean	1=small + medium 2=large	F-value	Significance ($p \leq 0.05$)
1.	Consumers making changes to their diet in recent years has resulted in lower sales of some of my company's products	1. x = 3.95 2. x = 3.45		4.159	0.043
2.	Factors other than consumer attitudes to sugar are more important to the success of my company	1. x = 2.01 2. x = 1.61		5.339	0.022
3.	In the long-run the sugar, diet and health debate is of little or no relevance to my company's success	1. x = 3.77 2. x = 4.27		4.865	0.028
4.	annual turnover	1. x = 0.58 2. x = 0.88		20.67	0.000
5.	Products manufactured and sold under a retailer's own label	1. x = 0.47 2. x = 0.81		9.383	0.003

1. small and medium companies n = 155
2. large companies n = 67

TABLE 5.43

STANDARDIZED CANONICAL DISCRIMINANT FUNCTIONS COEFFICIENTS

(Small/Medium and Large Companies)

Variables (abbreviated)		Function 1
1.	Sugar is a natural part of a balanced diet	0.27035
2.	Small number consumers worried sugar bad for health	0.19103
3.	Consumer attitudes encouraged company use alternative sweeteners	0.18951
4.	Taste most important reason company uses sugar	-0.14863
5.	Cutting back sugar another eating fad	0.14816
6.	Consumers not very interested individual sugar consumption	-0.31059
7.	Recommendation some health experts is realistic	0.32512
8.	Up to individual think about balanced diet	0.18402
9.	Small reduction sucrose better for nation's health	0.16329
10.	Company fully aware dietary recommendations	-0.29188
11.	Other factors more important companies success	-0.42870
12.	Current concerns no difference in long-run	0.28272
13.	In long-run debate not relevant company's success	0.35340
14.	Manufacture products sold under retailers own label	0.66636
15.	Products promoted and marketed of "health eating" segment	0.16721
16.	Claims "sugar free"	-0.48736
17.	"sugar reduced"	1.24367
18.	"no additives"	-0.39144
19.	"low calorie"	1.34061
20.	"no artificial flavourings"	-0.62331
21.	"none of these"	-1.31652

Canonical Discriminant Functions Evaluated at Group Means (Group Centroids)

1.	small and medium company	-0.46760
2.	large company	1.08176

TABLE 5.44

CLASSIFICATION RESULTS FOR SMALL AND MEDIUM COMPANIES COMBINED AND LARGE COMPANIES

Actual Group		No. Cases	Predicted Group Membership	
			1 med+small	2 large
1.	Small and medium companies	155	122 78.7%	33 21.3%
2.	Large companies	67	14 20.9%	53 79.1%

Percent of grouped cases correctly classified = 78.83%

5.6.5 Univariate and multivariate analysis between small and medium companies

5.6.5.1 Univariate analysis

Four attitudinal statements were statistically significant in distinguishing between small and medium companies (Table 5.45). Small companies agreed more strongly that sugar was used for a combination of its technical properties and that consumers are not very interested in their individual sugar consumption. Medium companies would be more likely to find it is "technically" possible to reduce some of the sucrose in their company's products. They were also likely to less strongly agree that it is up to the individual to think about whether they are getting a balanced diet.

5.6.5.2 Multivariate analysis

The results from a discriminant function analysis shows that the interaction between the 14 variables tested in Table 5.46 significantly discriminates between small and medium companies defined by turnover (canonical correlation = 0.54).

When used to predict group membership of responding companies, for small companies the classification rate was 76.1% or 67 out of 88 companies. The classification for medium companies was 73.1% or 49 out of 67 companies (Table 5.47). The percent of grouped companies being correctly classified using the variables in Table 5.46 was 74.84%.

TABLE 5.45

UNIVARIATE ANALYSIS OF VARIANCE COMPARING SMALL AND MEDIUM COMPANIES DEFINED BY ANNUAL TURNOVER

	Variable	mean 1=small + 2=medium	F-value	Significance ($p \leq 0.05$)
1.	Sugar is used by my company for a combination of its technical properties	1. x = 1.84 2. x = 2.42	4.324	0.039
2.	Consumers are not very interested in their individual sugar consumption	1. x = 3.48 2. x = 3.88	4.323	0.039
3.	It is "technically" possible to reduce some of the sucrose in my company's products	1. x = 3.68 2. x = 2.90	6.550	0.012
4.	It is up to the individual to think about whether they are getting a balanced diet	1. x = 1.95	4.621	0.033

Small companies n = 88
Medium companies n = 67

TABLE 5.46

STANDARDIZED CANONICAL DISCRIMINANT FUNCTIONS COEFFICIENTS

(Small and Medium Companies)

Variables (abbreviated)		Function 1
1.	Sugar is used combination of its technical properties	0.38624
2.	A small number consumers worried sugar bad for their health	-0.16857
3.	Consumers making changes resulted lower sales some products	0.22290
4.	Consumer confused about what is and is not balanced diet	0.21458
5.	Consumers not interested in individual sugar consumption	0.27540
6.	"Healthy Eating" only small part in marketing strategies	0.20266
7.	"Technically" possible reduce sucrose in products	-0.58181
8.	Up to individual to think about getting balanced diet	0.37605
9.	Small reduction sugar consumption better nation's health	0.42327
10.	Company fully aware dietary recommendations	-0.33169
11.	Consumer concerns about diet no difference in long-run	0.31238
12.	In long-run debate no relevance company's success	-0.49735
13.	Worthwhile explore using other sweeteners	0.38213
14.	Company manufactures products sold retailer's own label	0.32877

Canonical Discriminant Functions Evaluated at Group Means (Group Centroids)

1.	Small company	- 0.55476
2.	Medium company	0.72864

TABLE 5.47

CLASSIFICATION RESULTS FOR SMALL AND MEDIUM COMPANIES

Actual Group		No. Cases	Predicted Group Membership 1	2
1.	Small companies	88	67 76.1%	21 23.9%
2.	Medium companies	67	18 26.9%	49 73.1%

Percent of grouped cases correctly classified = 74.84%

5.6.6 Univariate and multivariate analysis between companies that 'have' and 'have not' promoted and marketed products since October 1983 aimed at the "healthy eating" market segment

5.6.6.1 Univariate analysis

Ten variables were statistically significant in distinguishing between companies that either had or had not marketed products aimed at the "healthy eating" market (Table 5.48). Companies that answered "YES" (n=117) to the statement disagreed less strongly with companies answering "NO" (n=105) that consumer attitudes towards sucrose had encouraged their company to develop products using alternative sweeteners. They also disagreed that cutting back on sugar by consumers was just another eating fad while those answering "NO" were likely to agree with this. Predictably the "YES" companies disagreed strongly that consumer views on 'healthy eating' had played only a small part in their company's marketing strategies.

Those answering "YES" agreed it is "technically" possible to reduce sucrose in their products compared to those answering "NO" and were likely to agree more strongly that a small reduction in average sucrose consumption would be better for the nation's health. Those answering "YES" also agreed more strongly that the "healthy eating" lifestyle is here to stay and disagreed more strongly that, in the long-run, the sugar diet and health debate is of little or no relevance to their company's success.

Those answering "YES" had a larger number of employees and a larger annual turnover than those answering "NO" and were more likely to have used the "healthy eating" claims listed in the questionnaire.

TABLE 5.48

UNIVARIATE ANALYSIS OF VARIANCE COMPARING COMPANIES THAT "HAVE" AND "HAVE NOT" PROMOTED AND MARKETED PRODUCTS SINCE OCTOBER 1983 AIMED AT THE "HEALTHY EATING" MARKET SEGMENT

	Variable	mean	1=YES + 2=NO	F-value	Significance ($p \leq 0.05$)
1.	Consumer attitudes towards sucrose have encouraged my company to develop products using alternative sweeteners	1. = 3.71 2. = 4.62		13.45	0.00
2.	Cutting back on sugar consumption by consumers is just another eating fad	1. = 3.74		14.49	0.00
3.	Consumer views on "healthy eating" have played only a small part, if any, in my company's marketing strategies to date	1. = 4.32 2. = 2.89		44.65	0.000
4.	It is "technically" possible to reduce some of the sucrose in my company's products	1. = 2.95 2. = 3.59		6.033	0.015
5.	A small reduction in average sucrose consumption would be better for the nation's health	1. = 2.52 2. = 3.02		9.331	0.00
6.	The "healthy eating" lifestyle is here to stay	1. = 2.19 2. = 2.58		6.035	0.01
7.	In the long-run the sugar, diet and health debate is of little or no relevance to my company's success	1. = 4.21 2. = 3.62		8.368	0.00
8.	Number of employees	1. = 1.97 2. = 1.56		10.47	0.00
9.	Annual turnover	1. = 2.22 2. = 1.69		14.92	0.00
10.	Claims "none of these"	1. = 0.03 2. = 0.65		14.51	0.00

5.6.6.2 Multivariate analysis

The results from a discriminant function analysis show that the interaction of 18 variables (listed in Table 5.49) significantly discriminates between companies that have or have not, since October 1983, specifically promoted and marketed products at the "healthy eating" segment (canonical correlation = 0.67).

When used to classify group membership of responding companies for those that had promoted and marketed products aimed at the "healthy eating" segment the classification rate was 86.3% or 101 out of 117 companies. For companies that had not specifically marketed products the classification was not so good with the rate being 77.1% or 81 out of 105 companies (Table 5.50). However, the overall percentage of cases correctly classified was still good at 81.98%.

TABLE 5.50

CLASSIFICATION OF COMPANIES PROMOTING AND MARKETING PRODUCTS AIMED AT THE "HEALTHY EATING" SEGMENT

Actual Group	No. Cases	Predicted Group Membership 1 = YES	2 = NO
1. "YES"	117	101 86.3%	16 13.7%
2. "NO"	105	24 22.9%	81 77.1%

Percentage of grouped cases correctly classified = 81.98%

TABLE 5.49

STANDARDIZED CANONICAL DISCRIMINANT FUNCTIONS COEFFICIENTS

Variables (abbreviated)		Function 1
1.	Develop products using alternative sweeteners	-0.15454
2.	Cutting back on sugar consumption another fad	0.25578
3.	Consumers not interested in individual sugar consumption	-0.24342
4.	"Healthy eating" small part marketing strategies	0.46121
5.	"Technically" possible reduce sucrose in products	-0.19954
6.	Cut sugar consumption by half is realistic target	0.19166
7.	Up individual think about balanced diet	0.14906
8.	Small reduction in average sucrose consumption better	-0.13138
9.	Consumer concerns no difference consumption long-run	0.13583
10.	Sugar-free, sugar-reduced always small market segment	-0.36781
11.	Annual turnover	0.30102
12.	Claims: "sugar free"	-0.43379
13.	"sugar reduced"	-0.80564
14.	"no added sugar"	0.99631
15.	"no additives"	0.41490
16.	"no artificial flavouring"	0.40898
17.	"high fibre"	0.64076
18.	"none of these"	-0.31640

Canonical Discriminant Functions Evaluated at Group Means (Group Centroids)

1.	"YES"	0.86019
2.	"NO"	-0.95850

5.6.7 Univariate and multivariate analysis between companies that "do" and "do not" manufacture products sold under a retailers' own label

5.6.7.1 Univariate analysis

Seven variables were statistically significant in distinguishing between companies that "do" and "do not" manufacture products sold under a retailer's own labe (Table 5.51). Companies that "do" agreed more strongly that sugar was used for a combination of its technical properties and also that a small number of consumers are worried sugar might be bad for their health. Companies that "do" manufacture for retailers agreed it was "technically" possible to reduce some of the sucrose in their products while those who "do not" disagreed. Companies manufacturing for retailers agreed more strongly it is up to the individual to think about whether they are getting a balanced diet. They also agreed it is now worthwhile exploring manufacturing products using sweeteners other than sucrose, while those who "do not" manufacture disagreed. Companies manufacturing retailers' own label products also tended to have a larger number of employees and a larger annual turnover.

TABLE 5.51

UNIVARIATE ANALYSIS OF VARIANCE COMPARING COMPANIES THAT MANUFACTURE PRODUCTS SOLD UNDER A RETAILER'S OWN LABEL

	Variable	mean 1=YES + 2=NO	F-value	Significance ($p \leq 0.05$)
1.	Sugar is used by my company for a combination of its technical properties	1. x = 1.76 2. x = 2.58	14.22	0.000
2.	A small number of consumers are worried sugar might be bad for their health	1. x = 2.07 2. x = 2.50	5.81	0.017
3.	It is "technically" possible to reduce some of the sucrose in my company's products	1. x = 2.95 2. x = 3.86	11.31	0.000
4.	It is up to the individual to think about whether they are getting a balanced diet	1. x = 2.01 2. x = 2.38	5.10	0.025
5.	My company now considers it worthwhile to explore manufacturing products using sweeteners other than sucrose	1. x = 3.25 2. x = 3.81	4.94	0.027
6.	Number employees	1. x = 1.97 2. x = 1.38	21.24	0.000
7.	Annual turnover	1. x = 2.13 2. x = 1.64	11.35	0.000

1. "YES", n = 150
2. "NO", n = 74

5.6.7.2 Multivariate analysis

The results from a discriminant function analysis show that the interaction of 20 variables (listed in Table 5.52) significantly discriminates between companies that do or do not manufacture products sold under a retailer's own label (canonical correlation = 0.55).

When used to predict group membership of responding companies for those who manufactured retailer's own label products 78% or 117 out of 150 companies were classified correctly. For companies which did not manufacture for a retailer's own label 79.7 or 59 out of 74 companies, were classified correctly (Table 5.53). The overall percentage of cases classified was 78.57%.

TABLE 5.53

CLASSIFICATION OF COMPANIES MANUFACTURING PRODUCTS SOLD UNDER A RETAILER'S OWN LABEL

Actual Group		No. Cases	Predicted Group Membership 1 = YES	2 = NO
1.	"YES"	150	117 78.0%	33 22.0%
2.	"NO"	74	15 20.3%	59 79.7%

Percent of grouped cases correctly classified 78.57%

TABLE 5.52

STANDARDIZED CANONICAL DISCRIMINANT FUNCTIONS COEFFICIENTS

Variables (abbreviated)		Function 1
1.	Sugar is a natural part of a balanced diet	0.20771
2.	Sugar used combination technical properties	0.33334
3.	Small number consumers worried sugar bad for health	0.17792
4.	Taste most important reason sugar used	-0.20790
5.	"Healthy Eating" only small part in marketing strategies	0.23259
6.	"Technically" possible reduce sucrose in products	0.20132
7.	Sugar consumption cut in half is realistic target	0.21492
8.	Company fully aware dietary recommendations	-0.27490
9.	Factors other than consumer attitudes to sugar	-0.18161
10.	In long-run sugar debate little relevance company's success	0.18342
11.	Worthwhile explore using other sweeteners	0.20853
12.	Up to individual to get balanced diet	0.30480
13.	Number employees	-0.40620
14.	Annual turnover	-0.29987
15.	Claims: "no sugar"	1.00964
16.	"sugar free"	-1.02109
17.	"no preservatives"	-0.86943
18.	"no artificial flavourings"	0.73635
19.	"no artificial colourings"	-1.19578
20.	"contains artificial sweetener"	1.07814

Canonical Discriminant Function Evaluated at Group Means (Group Centroids)

Group 1	"YES"	-0.46131
Group 2	"NO"	0.93509

5.7 Comments Received From Respondents

5.7.1 Introduction

The final question (Question 10) on the 1988 National Survey of Sugar and Sweetener Users invited comments from respondents on any of the points raised by the questionnaire, especially in relation to consumer attitudes to sugar, diet and health. A total of 61 comments were received as part of Question 10 (27.2% of respondents, n=224) and of these 45 were on the subject of sugar, diet and health (20.1%, n=224). The majority of the other comments referred to the European Community Sugar Regime and three comments about the questionnnaire itself.

The 45 comments dealing with the issue of sugar diet and health were analysed manually and for this purpose they were placed into five broad groups based on the comments made rather than a pre-determined structure. These groups are as follows:

a. Comments about consumer knowledge, information and understanding of the issue.
b. Comments that were product orientated.
c. Comments on trends and sales of sugar and sugar-free products.
d. Comments on the importance and role of sugar in the diet.
e. General comments mentioning other factors.

Comments are identified by the respondent's code number and whether they are a large, medium or small company as defined by turnover, other information is not provided since respondents were assured confidentiality.

5.7.2 Comments about consumer knowledge, information and understanding of diet and health

The general theme running through the following comments suggests respondents believe consumers are confused and being mislead on sugar and diet issues and the media is partly to blame, for example:

> "Although consumers may well be concerned about sugar consumption, they are concerned because many health professionals, who use the media very effectively, have presented erroneous and misleading messages about sugar. There are no sound medical or dental reasons to recommend reductions in sugar consumption. Sugars, like starches are carbohydrates and should be treated accordingly. See FDA Report 1986. In addition, the contribution made to eating enjoyment from confectionery, derived to a significant extent from sugar's taste and texture, is usually ignored in the sugar debate." (No. 385, large company)

Another company linked consumer concern with media pressure and argued that "fads" or "fashion" were just as important:

> "Consumer awareness of a link between diet and health has been raised by media pressure, but the level of real understanding and knowledge is still very low. Opinions are affected more by correct 'fashion' than by understanding, for example, jogging, as a fitness fad, reached its peak of popularity a couple of years ago and is now on the wane. Fibre is currently fashionable and appeals to the English puritanical streak and obsession with bowel action, but they will get bored with it in a couple of years time."

> "In general, there is an uninformed feeling among the public that sugar may be bad for you, but not to the point that there is going to be any major swing away from confectionery products. For the majority of people food price is a more important consideration than its health image. The obsession with sugar, fibre, no additives etc. is a luxury of the affluent middle class. I predict the next focus of their attention will be pesticide residues. There is a market for food with a 'healthy image', but it is fickle and a minority market only." (No. 110, large company)

A comment supporting this idea of concern about sugar being a "fad" sees the future watchword being "moderation":

> "...people are better educated and seem to be adopting a 'everything in moderation' attitude apart from the minority which are catered for by a readaptation of manufactured products which are not really anything different than the main products but are marketed with sophistication." (No. 697, small company)

Other respondents were clearly angered and annoyed by the amount of "misinformation" on diet:

> "... the consumer is totally confused by the mass of conflicting information. Newspapers and broadcasters giving false information should be prosecuted." (No. 318, medium company)

and:

> "... some programmes on T.V. and some of the adverts are very anti-sugar and are encouraging consumers to look more closely at the ingredients used in many foods and as a result sugar based products are getting badly 'knocked' at the moment." (No. 943, small company)

or, regarding food additives:

> "The public have been completely brainwashed in respect of E Numbers and think every product with an E Number is harmful to their health. Consequently they are now looking for products which state No preservative, No artificial flavourings, No additives etc. - but if you were to cut up an orange all those E numbers would be there in greater proportions. The damage is irreversible..." (No. 1006, medium company)

Many respondents felt that the consumer was confused about diet and this view was echoed in some of the comments:

> "I continue to be amazed at the lack of understanding about food and drink in the community, for example, a recent 'phone call from a lady whom I assumed to be a Miss or Mrs Joanna Public showed ignorance of the fact that Pure Apple Juice contained sugar as a food constituent ... I am in favour of declaring the ingredients of food and drink, but this must be accompanied by a national effort to educate people to understand what we as manufacturers in our industry are trying to convey." (No. 1016, medium company)

or:

> "We occasionally get a customer who writes to discuss the properties of sugar and its place in a normal diet. It is found, usually, that by a reasoned presentation of the facts the customer sees and understands that sugar has a place in a balanced diet." (No. 489, small company)

One respondent felt the consumer needed a more open approach to the question of "balance" rather than concentrating on individual aspects of the diet and went on to say:

> "We are in grave danger of giving the consumer too much information which they either do not understand or more dangerously misunderstand (witness the Doctors who are treating several adolescents for malnutrition - the children are on the parent's diet. The average adolescent needs all the sugars, fats etc., up to 3,500 calories per day just to grow! This is a classic case of bad misinformation)." (No. 216, small company)

The question of the young was also mentioned in another comment:

> "The young (up to 25 year olds) especially those at school are very aware of diet. The main reason seems to be - reduce meat - eat a more vegetarian diet. My own opinion is that a backlash and ever increasing snack food market will emerge. Education and what is presented to children is very important. If it tastes awful it must be healthy, is a danger." (No. 729, large company)

A summary of some of the themes raised in the comments above could be this comment from one respondent:

> "It is clearly beneficial to the consumer at large to have a greater understanding of the relationship between diet and health. It is important that a balanced view on the intake of sugar, fats etc. is made available to the general public so that unnecessary scares etc. do not happen." (No. 497, large company)

and on the subject of fat it was unexpected that there was only one comment like this:

> "Our company has been affected more by consumers attitudes to oils/fats than sugar, re COMA report." (No. 500, large company)

There were also two "anti-sugar" comments made:

> "I feel that there is not enough consumer concern about diet and health in relation to sugar consumption. There is no doubt in my opinion, that sugar does contribute, to a larger extent, in many major medical disorders, but this has not been forcibly brought to the attention on any large scale to the consumers. There is no doubt however that sometime in the future this situation will change and sugar consumption will see a dramatic fall." (No. 231, small company)

and:

> "Consumers must be made more aware of the poor and damaging quality of sugar as a food." (No. 36, small company)

5.7.3 Comments that are product orientated

Ice-cream manufacturers felt there was little they could do because of the nature of their products:

> "It was very difficult for me to answer some of these questions because being an ice-cream manufacturer it is practically impossible to make ice-cream without sugar as much as we have looked into the possibility..." (No. 236, small company)

and:

> "1. Difficulty with ice-cream is that use of artificial sweeteners is not permitted at all. Therefore it is difficult to make any real sugar savings.
> 2. Second difficulty with ice-cream and mousse, is that if sugar is cut, some other ingredient such as polydextrose has to be used to bulk up the product." (No. 522, small company)

but, on the other hand:

> "Ice-cream must have sugar because it is a fat-sugar ratio. Our sales are geared to sunshine. Raspberry Ripple ice-cream, which is a high sugar product, is one of the top selling lines." (No. 711, medium company)

Other comments from respondents based around their products concentrated on what the consumer wants:

> "We aim to fulfill the consumer demand for products, whether 'healthy eating' or otherwise. We do not educate the consumer as to the relative merits of particular dietary patterns. The 'healthy eating' campaign has been led, in our opinion, by supermarket chains seeking maximum publicity." (No. 621, large company)

and this is reflected in the demand for products:

> "The general public are more aware of the dangers of over use of sugar in their diet and this is reflected by sales of those products that have high levels of sugar as an ingredient. Most fruits in cans have low syrup levels now, a few years ago they were high levels." (No. 570, large company)

and the opportunity to niche marketing:

> "A common buzz word at present is 'niche' marketing. Products targeted to consumer attitudes on sugar, diet and health are often niche products because only small segments of the population espouse as issue strongly enough to buy products aimed at a particular issue (have confectionery sales fallen? No!). Few 'healthy' products enter the general diet -yoghurt stands out as the major success. The product must taste good and the search for absolutes (sugar free rather than sugar reduced) works against palatability..." (No. 352, medium company)

One respondent, however, while aware of sugar and its role in the diet, believed the use of sucrose was preferable to alternatives:

> "Our attitude to sugar in our products is that it is a food, used in moderation. I feel that many people consume too much especially from the point of view of dental health. However, because I see it as part of the food value of my products I would never replace it with artificial sweeteners, which I see as 'cosmetic' in the same way as colourings and flavourings." (No. 38, small company)

5.7.4 Comments on trends and sales of sugar and sugar-free products

This section ties in very closely with the previous section on product orientated comments, however, the comments below have been singled out for their insights into whether current concerns about sugar, diet and health is a passing issue, for example:

> "Some comments are being made on the subject of sugar, of fat, butter, etc. but these do not seem to have lasting effect." (No. 291, small company).

and:

> "We do make 'no added sugar' products, but the uptake is low and not moving upwards." (No. 774, small company)

One respondent (perhaps echoing the views of many consumers) wrote about the changing nature of dietary advice:

> "Consumer attitudes at this time are against excess use of sugar. However, the long term taste and 'sweet tooth' of the British Public, will I think always leave the anti-sugar faction of the public

> in the minority. As with many products we are told today they are not good for use and then a few years later it will be stated that it is essential to eat a balanced quantity of these products to maintain a balanced diet..." (No. 403, small company)

Some respondents feel if there is to be a change in sugar consumption on overall health grounds it will be very gradual:

> "We own a Health Food Shop. It is my impression that only a minority of the public are concerned to cut down sugar on overall health grounds but a majority are concerned in order to lose weight." (No. 80, small company)

and:

> "Sugar-free products will become more important, but this will be a very slow process due to:
> 1. Lack of easy availability of alternative sweeteners
> 2. The cost of setting up the new production processes, especially for small/medium size manufacturers
> 3. and possibly most importantly, the attitude of a) trade buyers b) consumers who are not easily persuaded to pay (currently) almost double price for the same weight of confectionery product." (No. 410, small company)

and traditional products will still be as popular:

> "We are a relatively small company and do not use large quantities of sugar. We are aware of the public attitude at present which seems to be moving slowly towards health-type foods, for example, meusli biscuits, 'oatflake' cookies, 'wholemeal' shortbread. In our experience the trend is gradual and we feel the more traditional type products will be around for a considerable time yet." (No. 103, small company)

Only two comments were very positive about the current trend to "healthier" products:

> "Current sales trends show a definite interest in healthy eating (for example, reduced red meat, increased pasta, fish and chicken dishes). High fibre, vegetarianism and special dietary requirements reflect increased consumer/caterer awareness." (No. 504, large company)

and:

> "Sugar free foods are definitely going to be larger in the future. More and more people are thinking health and not fat." (No. 968, medium company)

5.7.5 Comments on the importance/role of sugar in the diet

All comments from respondents on the role of sugar in the diet were that, while care needs to be taken regarding teeth, in moderation sugar is a proper part of a balanced diet, for example:

> "It has been demonstrated by the Government chemist of the U.S.A. and accepted unreservedly in the U.K. that sugar does not pose any healthy hazards other than dental caries (together with other carbohydrate based foods). The relationship between sugar and health is the same as the relationship between food, diet and health - moderation." (No. 278, large company)

and:

> "Our company agrees that the consumption of sugar is detrimental to people's teeth. We do not agree that it is detrimental to health and believe that sugar is very necessary to the diet. Many of the 'fads' as you call them are the result of the marketing strategy of multiple grocery chains who try to increase their market share by informing the consumer that they care about their health and their competitors do not." (No. 311, medium company)

and:

> "Sugar is still a natural product and as such should be considered as part of a balanced diet." (No. 321, large company)

and:

> "When diet experts are pinned down on the dietary effects of sugar, all they can really prove is that it is bad for teeth." (No. 287, small company)

Two comments referred to the role of sugar and young people:

> "These answers relate to baby food. Where used, sugar is part of a nutritionally balanced meal. Sucrose is used as part of the carbohydrate content only when its sweetness is also required." (No. 509, large company)

and:

> "Many people seemed inclined to think sugar is bad for us, but most mothers, although are inclined to agree, they realise that sugar is an important diet for everyone particularly young children." (No. 181, small company)

One respondent touched upon an important consideration when looking at sugar, diet and health:

> "Sugar is regarded more in terms of weight gain/loss within a diet rather than in 'healthy' eating." (No. 551A, large company)

5.7.6 General comments and other issues

Comments in this section relate to a range of other issues that have a bearing on the question of sugar in the diet. They represent a selection of "other issues" and their relative importance, as far as respondents are concerned, to the relevance of sugar and diet as an issue by itself, for example:

> "Consumer demand for our products remains strong but we would not be aware of any resistance to sugar in our products as many other factors can also affect our sales." (No. 109, medium company)

One of these "factors" was identified as advertising:

> "My opinion of consumer attitudes is that like cigarettes, if they like something they will buy it. People are led by advertising in the confectionery business, vast amounts of money are spent on telling people to buy confectionery and very little to tell them not to buy it." (No. 315, medium company)

or the price of raw materials:

> "I greatly believe that the high price controls of sugar inflicted by the European Community is grossly unfair ... and this I would say is the main reason for the decline in the British sugar confectionery manufacturers production and not the consumers attitude." (No. 418, small company)

or the fact that public or retail image is not that important in some cases:

> "In our particular business, which is supplying our pubs and outlets with beer, cider and soft drinks, the healthy product image is not as important as it would be in the supermarket. Our customer rarely sees the bottle to study the label declaration. Our soft drink philosophy is driven by two points:
> 1. All sugar drinks taste markedly superior to sugar/saccharin blends. The additional cost on 4oz. mixers is very small.
> 2. the female market insists upon low calorie drinks almost despite

> the taste. The use of aspartame gives a reasonable compromise between cost and flavour. It is also worth noting that our markets are typically less price sensitive than supermarket trade." (No. 889, large company)

The use of artificial sweeteners was also considered by another respondent:

> "A good cheap artificial sweetener would virtually eliminate the use of 'sugar' in the beverage industry. It is [currently] too expensive and is receiving bad press. Possible solution - price reduction or improve the current unhealthy image." (No. 966, medium company)

Importantly, the issue of "healthy eating" and catering was also raised:

> "You should be aware that there is a distinction between catering and retail. We are major suppliers to the catering industry and as such ingredient declarations rarely reach the final consumer. There also seems to be less of a 'concern' about healthy eating in a restaurant situation when customers see eating out as a treat." (No. 738, medium company)

Another factor given was unemployment:

> "We find that the only real cause for a drop in sales is the unemployment problem. Should there be job losses in a specific area, then our sales drop accordingly, we do not think that the 'unhealthy sugar factor' is a major worry at all." (No. 492, small company)

But finally, when all seems quiet, with sugar, there could always be trouble just around the corner:

> "Colours, additives and the 'fat' aspect has had more effect on consumers than sugar due to media coverage to date, but sugar is due for stronger attention and in my opinion will be more controversial due to more political aspects." (No. 234, small company)

CHAPTER SIX

GENERAL DISCUSSION: TOWARDS A SUGAR-FREE NATION?

6.1 Introduction

This Chapter discusses the results of the National Survey together with some of the broader issues relating to sugar consumption. Before doing so, some of the pertinent features of sugar as a commodity will be briefly mentioned again to emphasise the widespread use of sugar in the food chain and the global magnitude of its production and availability.

To start with, it will be remembered that it was in less than two centuries that sugar in the diet surrendered its place as a luxury and rarity and became, by the turn of the twentieth century, the first mass-produced necessity of a proletarian working class (Mintz, 1985). In historical terms the widespread consumption of sugar is relatively new. As the consumption of sugar spread to greater numbers of the population it also spawned new sectors of the rapidly expanding food and drink industries. These not only relied on the taste of 'sweetness' sugar imparts, but the whole range of sugar's functional properties (Hugill, 1979). Sugar, as an ingredient, has become synonymous with the modern food system and its diverse range of food and drink products.

Every country that can be is a recognised sugar cane or sugar beet grower (Grissa, 1976) and world production approaches or exceeds more than 100 million tonnes annually (International Sugar Organisation, 1987). Production has become so widespread and successful that capacity substantially exceeds possible consumption. As a result sugar as a traded commodity, has been dogged by poor prices because, when prices rise, response to this is usually quick, but when prices fall response, by curtailing production, is weak, creating surpluses. Added to this problem, governments have a bias

to rescue production levels for social, political and other extra-economic reasons (Barry, 1987).

Only around 15-20% of total sugar production is 'freely' traded on the world market. The majority of production is tied to pre-arranged contracts or institutional support mechanisms such as the EC Sugar Regime. In short, world sugar production in most years runs surplus to consumption. Since 1900, in eight years out of ten supply has exceeded demand and prices were low (Green Europe, No. 180, June 1981). As Figure 3.1 showed, U.K. production, while falling, has exceeded consumption every year between 1974 and 1984. For 1986/87 supplies available for consumption were 2,621,000 tonnes but actual domestic consumption was 2,285,000 tonnes.

In other words, the production of sugar is in many respects divorced from consumption and pressures on consumption, even though, the past decade has seen added pressures in this area. Competition from sucrose substitutes, especially High Fructose Corn Syrups, have eroded the use of sucrose in markets such as the U.S.A. and Japan, while aspartame has grown as an important low-calorie sweetener. Coupled to this has been the slowing down and in some cases a fall in consumption in the developed world (Harris, 1985) while incomes in many developing countries, with below average sugar consumption, have remained too low to stimulate further sugar demand.

The developed world has also seen a growing medical consensus about the links between good diet and the prevention of many 'Western Diseases' (Trowell and Burkitt, 1981). In some instances refined sugar has been singled out as a major constituent in a diet that could possibly be injurious to health (Cleave, 1974), or that it is best to avoid eating too much (Truswell, 1987b). In the light of this consensus on diet and health, the majority of developed countries have produced dietary goals and guidelines for individuals and for the general population. Many of these specifically suggest a reduction in sugar

consumption (Truswell, 1987a). In the U.K., between 1974 and 1986 the conclusion to be drawn from eight reviews of diet and health by expert committees is that sugar intakes should, in general, be reduced. Three suggest a halving of current average national sugar consumption, the others recommend either to eat less or not to increase present intakes. They also suggest being careful about eating manufactured food and drinks containing sugar (see Chapter Two for full details).

Dietary recommendations regarding sugar have added authority to already negative attitudes towards sugar by consumers. Market research time and time again shows the consumer as saying sugar is a food that should be reduced for a healthy diet or is a food perceived as being "bad" for you. However, the survey results suggest food and drink manufacturers see this view as "confused".

Still, sugar, in its white granulated table-top form, has suffered as a result. Household consumption has more than halved in the past 20 years. It now stands at less than one kilo bag of sugar per person per month (11.69 kg/person/year - NFS, 1986). However, more sugar is purchased by the food and drink industry and industrial use was some 300,000 tonnes greater in 1984/85 than in 1965/66. In the mid-1980's more than two-thirds of the sugar used in Britain was accounted for by its industrial use in food and drink manufacture. This use, in turn, is concentrated in a small number of food categories, namely soft drinks, confectionery, baked products, biscuits and cereals. These are all product categories in which dietary advice generally says cut back on eating, or avoid eating too much.

In a recent survey (Food Policy Research Unit, 1986), 86.6% of respondents (n=576, all female) agreed with the statement:

"There is too much sugar used in food manufacturing."

and 92.4% (n=576) agreed with the statement:

"Children should eat less foods containing sugar."

Dietary advice and dietary guidelines recommend that sweet foods with added sugar should be restricted, even if it is only to help in preventing eating too much fat (COMA, 1984). Overall U.K. sugar supplies entering the food chain have declined by 25%, from around 50kg/person/year in the 1950's to 37kg/person/year in the 1980's, although some of this use was substituted by glucose syrups.

A possible hypothesis of the impact and the degree of success of dietary guidelines regarding sugar is that any major change in sugar consumption habits by the consumer may be reflected in the range of manufactured food and drink products using sugar as an important ingredient. This could then form the basis for speculating on the influence of changing patterns of sugar consumption on food and drink manufacturers, paying particular attention to the issue of sugar, diet and health.

6.2 The National Survey of Sugar and Sweetener Users

The National Survey of Food and Drink Manufacturers who use sugar and sweeteners was carried out at the beginning of 1988 to explore the attitudes of food and drink manufacturers on the subject of sugar, diet and health (see Chapter Five). The fundamental aim of the survey was to test the above hypotheses. The more specific aims were to:

1. Obtain a representative sample of food and drink manufacturers producing sugar containing foods.
2. Establish the main areas of difference between respondents.
3. Discover if there was a consensus of opinion on the subject.
4. Identify further research areas.

These aims are discussed more fully in the following sections.

Respondents to the survey are a representative sample of the sectors of the food industry using sugar and sweeteners. Respondents represented a good spread of product categories (Table 5.2) and reported a substantial percentage of the total amount of bought sugar for industrial use. The 164 companies which indicated their purchases of sucrose used more than half a million tonnes of sucrose in 1986, a third of the total industrial market, and 164,000 tonnes of glucose syrups, more than 40% of U.K. production. By matching these responses to similar non-responding companies the amount of sucrose bought is estimated to be around 650,000 tonnes, nearly half the industrial market. There was also a relatively even spread of replies from small, medium and large companies that purchase sugar.

6.2.1 Differences between companies

Responding companies were distinguished from each other in their attitudes and response to the issue of sugar, diet and health in a number of important respects. These include company size (defined by annual turnover), whether they have already promoted products to a "healthy eating" market segment, and whether they manufacture products sold under a retailer's own label (see Tables 5.36 to 5.52).

The largest distinction, when comparing company size, is between small and large companies with the discriminant analysis classifying 86% of respondents correctly. From the univariate analysis, the two areas of "disagreement" are; firstly, small companies tend to believe cutting back on sugar consumption by consumers is just another eating fad while, in comparison, large companies disagreed ($p=0.047$). Secondly, large companies tended to agree that it is "technically" possible to reduce some of the sucrose in their company's products, while small companies disagreed ($p=0.019$).

Between medium and large companies the statistical differences can be interpreted largely as ones of degree. For example, large companies agreed more strongly, when compared to medium companies, that consumers making changes to their diet had resulted in lower sales of some products. The same holds true for small and medium companies combined, in comparison to large companies. Again it is the degree of agreement or disagreement held that is important. However, in both cases, around eight out of ten respondents were successfully classified by the discriminant analysis. The least distinction was between small and medium companies (75% correctly classified). The only major area of "disagreement" was that medium companies were more likely to agree that it is "technically" possible to reduce some of the sucrose in their products, while small companies disagreed (p=0.012).

The next group examined was the companies that had promoted products aimed at the "healthy eating" segment and those who had not. Companies answering "yes" to this question tended to disagree with the statement that cutting back on sugar consumption by consumers is just an eating fad, whereas those who answered "no" were likely to agree (p=0.000). Companies answering "yes" were also more likely to agree that it is "technically" possible to reduce some of the sucrose in their products, while the "no's" disagreed (p=0.015). This last statement was also important for companies manufacturing products sold under a retailer's own label, with companies that do manufacture for a retailer agreeing and companies that did not tending to disagree (p=0.000). Companies manufacturing for retailers also agreed it is worthwhile to explore manufacturing products using sweeteners other than sucrose while the "no's" disagreed (p=0.027).

In summary, the univariate and multivariate analysis statistically distinguishes between different groups responding to the survey. The most accurate classification is between small and large companies and between

companies that have or have not promoted and marketed products aimed at the "healthy eating" segment. In comparing the statistically significant variables from the univariate analysis and the groups examined, a number of the variables commonly occur suggesting they are important in distinguishing attitude and response to the issue of sugar, diet and health, namely:

- It is "technically possible to reduce some of the sucrose in my company's products.
- In the long-run the sugar, diet and health debate is of little or no relevance to my company's success.
- Does your company manufacture products sold under a retailer's own label?
- Consumers are not very interested in their individual sugar consumption.
- Consumers making changes to their diet in recent years has resulted in lower sales of some of my company's products.
- Marketing "claims" as listed in the questionnaire.
- Factors other than consumer attitudes to sugar are more important to the success of my company.
- Cutting back on sugar consumption by consumers is just another eating fad.
- It is up to the individual to think about whether they are getting a balanced diet.
- Sugar is used by my company for a combination of its technical properties.

6.2.2 Sucrose: The Optimum Sweetener

To put the results of the survey of food and drink manufacturers into context the importance of sugar as used by respondents and their belief in its

role as a natural part of a balanced diet has to be stressed. This is strongly suggested by the survey results. The majority of products using sugar made by responding companies would not exist in their present form if it were not for the properties of sucrose (see Chapter Four). Also, 72.1% of respondents agreed that taste alone was the most important reason for using sugar. It is assumed that nearly all respondents are not cutting back on production of their sugar-containing foods and have not stopped marketing, selling and advertising bars of chocolate, full sugar soft drinks, biscuits, cakes and so on. This positive attitude to products containing sucrose is reflected in the results and must be borne in mind in any subsequent interpretation.

Backing this up, The Optimum Sweetener Factor was the strongest underlying attitude to emerge from the factor analysis, accounting for 30% of total variance. From the descriptive analysis, 89.7% of respondents agreed that sugar is a natural part of a balanced diet. The Optimum Sweetener Factor can be explored further by considering other attitudinal statements that bear on it. Nearly 60% of respondents disagreed that consumer attitudes to sucrose had encouraged them to develop products using alternative sweeteners. A majority (55.2%) agreed cutting back on sugar consumption was another eating fad and just under half (47%) agreed consumers are not very interested in their individual sugar consumption. Again just under half (48.2%) agreed consumer view on "healthy eating" had played only a small part, if any, in their company's marketing strategies to date.

It was the opinion of 62.6% of respondents that the recommendation by some health experts that average sugar consumption should be cut by half is a unrealistic target. Around four out of ten respondents (39.7%) disagreed that the majority of consumers are worred sugar might be bad for their health. Around the same number (43.3%) disagreed that the majority of consumers are actively trying to cut down on their individual sugar intakes. Slightly more

than a quarter (27.3%) agreed that current consumer concern about sugar will make no difference to average sugar consumption in the long-run and 71.7% agreed sugar-reduced or sugar-free products will always be a small market segment. Only a little over a third agreed that in the long-run the issue is of little or no relevance to their company's success.

In summary, there are strong suggestions from respondents that the sugar, diet and health issue is of little or secondary importance to many companies. On the other hand, while respondents were strongly supportive of sucrose, some companies recognise that consumer beliefs are having a more profound impact on sugar eating and hence attitudes to one of their major ingredients. This has been reflected in marketing and promotional activities, some of which are examined in Chapter Four. Although majorities considered consumers to be worried about sugar being bad for health and that consumers are actively trying to cut down on individual sugar intakes, a majority (55.2%) also consider such concern to be an eating fad.

6.2.3 The Impact of Dietary Advice on Food and Drink Manufacturers

The factor analysis produced three "factors" that can be interpreted as suggesting that there has been a considerable impact of dietary advice, through the consumer, on food and drink manufacturers. The "Lost Sales Factor" suggests manufacturers have seen consumers buying less of some of their products and attitudes to sucrose alone have resulted in lower sales of some products. This was felt more strongly by larger companies in comparison to small and medium companies (Tables 5.39 and 5.42). 50.7% of all respondents agreed consumers making changes to their diet in recent years had resulted in lower sales and 43% that attitudes to sugar alone had resulted in lower sales. It can also be speculated, however, that consumers making changes to their diet will mean sales of other products have increased.

The "Consumer Factor" also supports the impact of dietary change on manufacturers with respondents suggesting that they believe the majority of consumers now to be watching out for sugar in their diets. Finally, The "Alternative Sweetener Factor" suggests there has been some movement by manufacturers to explore producing products using sweeteners other than sucrose. 60.7% agreed they now consider it worthwhile to explore this option and 40.3% agreed consumer attitudes to sucrose have encouraged their company to develop products using alternative sweeteners.

More than half of all respondents answered "yes" to promoting and marketing products aimed at the "healthy eating" segment. However, the "healthy eating" segment can in many respects be interpreted as making claims about food additives rather than suggesting more fundamental changes in products. It can be seen from Table 5.8 that the "artificial" claims were heavily used by respondents. Larger companies were more likely to use these product claims and since they were also more likely to manufacture products sold under a retailer's own label, it is suggested retailers have had an important influence in this area. The use of the "sugar-free" type claims probably represents changes in the soft drinks market where these are widely used as part of the promotion "low-calorie" and "diet" soft drinks.

Long-term, the sugar, diet and health issue is relevant to 63.9% of all respondents and more than two-thirds (72.7%) agreed that current concerns will make a difference to average sucrose consumption. Even if companies believe it is a "fad" or unimportant they have had to take note of the sugar, diet and health issue and many companies have been able to amply exploit it to their commercial and economic advantage. However, comments made by some respondents (see Section 5.7) suggest that many believe consumers to be "misinformed" on the question of sugar, mainly as the result of (incorrect) media coverage. While a majority of respondents agreed with the statement

that it is up to the consumer to think about having a balanced diet, a large majority also agreed that the consumer was confused about what is and what is not a balanced diet. The question of "balanced diet" still remains a contentious issue.

6.2.4 A Consensus of Attitude and Response?

Research into policy issues generally requires that results must report large effects as well as being concerned about factors of enduring social importance (Hakim, 1987). The question of diet and health is considered throughout this work as something of enduring social importance. The survey helped to examine this issue regarding changes in sugar consumption. It is suggested that the results, while showing a consensus of opinion in one respect, also reveal two distinct underlying attitudes and responses by companies. For convenience these two "groupings" of company attitude and response will be called Group One and Group Two, although neither group is all inclusive. A profile of these two groups is suggested below and is used to discuss in broader terms responses by food and drink manufacturers to changing patterns of sugar consumption.

The distinction between Group One and Group Two is less obvious than it seems at first because both share a common thread of belief and attitude towards the issue of sugar, diet and health. Both Groups tend to reply positively to the following statements:

- Sugar is a natural part of a balanced diet
- The "Healthy Eating" lifestyle is here to stay
- Are aware of dietary recommendations about average sugar consumption
- A small number of consumers are worried sugar might be bad for their health
- Consumers are confused about what is a balanced diet
- Use sugar for a combination of its technical properties

- It is up to the individual to think about whether they are getting a balanced diet
- Factors other than consumer attitudes to sugar are more important to the success of my company

With these in mind, Group One companies tend to have the following characteristics:

GROUP ONE

- Smaller companies
- Unlikely to manufacture products sold under a retailer's own label
- Unlikely to have marketed products aimed at the "Healthy Eating" segment
- Less likely to have used "Healthy Eating" claims on their products
- Disagree that it is "technically" possible to remove sucrose from some of their products
- More likely to consider present consumer attitudes and cutting back on sugar consumption to be an eating fad

Group Two companies tend to have the following characteristics:

GROUP TWO

- Larger companies
- Likely to manufacture for a retailer's own label
- Have marketed products aimed at the "Healthy Eating" segment
- Used a variety of "Healthy Eating" claims on products

- Agree it is "technically" possible to reduce sucrose from some of their products
- Believe a small reduction in sugar consumption would be better for the nation's health

It is concluded that there is a consensus of opinion amongst respondents on the issue of sugar, diet and health - consumers are confused and possibly misinformed about sugar, which in turn is a natural part of a balanced diet. However, while the vast majority share this common attitude to the issue, response has been different, depending on whether a company tends towards the characteristics of Group One or Group Two. This in the main has allowed Group Two type companies, while defending the place of sugar in the diet, also to exploit, as they see it, perceived consumer fears and confusion about sucrose.

6.3 Final Commentary

It appears from the survey results that it is the larger purchasers of sugar who are also more likely to market "sugar-free" or "sugar reduced" products that imply, with claims about sugar, that these products are better because they contain less or no sugar, while of course still promoting their traditional product ranges.

The results also suggest consumer attitudes to sugar, while important, are not essential to company success, although, consumer attitudes have been exploited by those companies more able to respond. There is clearly a difference of opinion between companies who believe current consumer concern about sugar eating is a fad and those who do not, even though the majority accept the "healthy eating" lifestyle is here to stay.

The fact is, and remains so, that many existing product ranges would not exist in their present form without sugar and in many cases this use has been

developed over the long-term:

> "... the long-term sugar usage has led to inventiveness in exploitation of sugar's unique properties leading to unique food products in which the physico-chemical functionality of sugar has been advantageously employed to create foods." (Guggenheim, 1979)

It is the "technical" ability to respond, a key characteristic of Group Two respondents and in distinguishing between companies in the univariate analysis, that is really important, perhaps together with links to retailers, in the "healthy eating" market. In this respect it is the food systems with water as the technically feasible replacement bulk for sucrose, such as in soft drinks and yoghurts, where Group Two respondents have real advantages over other companies.

"Healthy eating", therefore, has come at the right time for the marketing of artificial sweeteners and there has been a surge of activity in this area. However, it is easier to document sugar substitutes than it is sugar substitution. In many food areas the products using sugar substitutes have supplemented existing markets (see Chapter Four) and/or attracted new consumers to a product range, such as with canned fruit in "natural juice" ("The Grocer", August 9, 1986, p.44). The "healthy eating" market has expanded the total sugar and sweeteners market, driven in the main, not by consumer attitudes to sugar per se, but rather:

> "The competition of the high intensity products is fuelled by fear of obesity, fashion considerations and cultural factors, as well as expectations of lower cost per unit of sweetener. This continues to produce a powerful, almost irresistible combination." (Viton, 1987)

Remember, only 40.3% of survey respondents agreed consumer attitudes towards sugar had encouraged their company to develop products using alternative sweeteners, while 60.7% agreed it is worthwhile exploring manufacturing products using sweeteners other than sucrose. The cost

advantages of varying sweetening ingredients is also critically important in assessing the reason behind changes in sugar "consumption".

The consumer is probably more concerned with weight loss and weight control than the wider possible health considerations associated with sucrose intakes, although it is not clear how far "healthy eating" has taken over from slimming per se as a major concern. This may have contributed to the ready acceptance of sweet-tasting products, (although sweetened with artificial food additives), but there is no evidence whether or not an "artificially sweetened" product can be of help in modifying intakes. In this respect, permitted labels such as "diet" or "light" are being taken to imply usefulness in weight control that has not been demonstrated (Booth, 1987).

Some of the reasons given above suggest the low-calorie sector for sweet-tasting products in many areas would have developed regardless of consumer attitudes to sucrose, all other things being equal. Lifestyle is probably more important. As Bourdieu points out (see Chapter One) food consumption, as with the cultural consumption of all other resources, is a vehicle for social differentiation, of class inequality and the stratification of knowledge, aesthetic sensibilities and values (Bourdieu, 1979).

The use of sugar substitutes is no exception and consumption is also influenced by cultural factors. Artificial sweeteners are principally marketed on "taste", "style" and "image", hence the marketing slogan for NutraSweet is: "The taste the world is turning to". Currently, however, the world is still turning to sucrose which retains 90% of the global market, with alternative sugars accounting for 8% and high-intensity sweeteners about 2% (on a sucrose equivalent basis) (Anon, 1987).

The problem is the same for sucrose and sugar-containing products, not how to cut back using sucrose, but how to re-position it and products containing it, to fit in with changing cultural consumption patterns. The

image, not the medium, is the message. The present state of the food industry is characterised by strong branding and new product development. The traditional "sugar" products, such as confectionery and soft drinks, are still heavily advertised and marketed with sophistication, for example, Mars spent £53m on advertising in 1987 ("The Sunday Times", October 2, 1988, p.D11). There has been in recent years a marked development and increase in the number of convenience stores. The major product ranges stocked and sold through these outlets includes confectionery, soft drinks, ice-cream and snacks. These products are also increasingly sold through such outlets as garage fore-courts.

There is increasing co-operation between food and drink manufacturers and the major retailers who together try to identify ways to concentrate on developing higher added value products. The use of novel ingredients, such as sugar substitutes are ways of achieving this. It also gives the food manufacturer or retailer a monopoly market niche. For example, if you are the only company manufacturing, say, sugar-free jellies, you in fact have a monopoly in this market niche with the advantages this gives you. It will be noticed from "new" products listed in Chapter Four that in many cases the new product appears to be competitor led, that is, one company produces, for example, a sugar-free dry drink mix and a few months later a competitor launches a similar product, and so on.

This perhaps helps to explain the irrational behaviour of some food and drink manufacturers. From the survey it is clear both Group One and Two respondents see nothing incompatible with their sugar-containing products and sound nutritional practice by the consumer, with sugar being a natural part of a balanced diet. Yet the "confused" and "misinformed" consumer is provided with a range of products to compound this "confusion" with "sugar-free" and "no added sugar" labels on products. Surely this only serves to confirm, as

defined by the food and drink manufacturers themselves, this "misinformation". The food and drink manufacturer, quite rightly, argues it is not their job to educate the consumer, but to sell products and satisfy what the consumer wants. In this case, who then has the responsibility for this education? In a "free society" should anything as important as the good health of the whole population be left to something as uncertain as "choice"? Is it not the case then, that the onus for sound nutritional health should rest with government in the form of a national food and health policy as, for example, so energetically pursued by the Dutch government?

As Truswell says:

> "Looking ahead, I believe we need dietary guidelines - points that most nutritional scientists more or less agree with - as headings for nutrition education of the public and as suggestions for future planning by the food industry." (Truswell, 1987a)

and James argues:

> "I consider that the only reasonable approach for those involved in health education is to use consistently the views advocated by official committees." (James, 1988)

This is the crux of the problem because it returns to the fundamentals of dietary advice and why the advice is there in the first place - to help prevent and cure a myriad of diseases and improve the quality of an individual's life. So what has become of dietary advice in the throes of the marketing and selling of "healthy eating"? Many baby and infant drinks, for example, are promoted as "no added sugar", yet a selection of these drinks were tested and contained substantial quantities of "sugar". In some cases total sugar content was as high as 4.1 equivalent teaspoons of sugar (sucrose) in a volume which would normally be taken by a baby. It was concluded:

> "... The high sugar content of the drinks we tested indicates that they all have a high cariogenic potential. The fact that they have 'no added sugar' does not make them any less dangerous to teeth, especially when they are used frequently throughout the day." (Curzon et al., 1988)

It would seem that long-term dietary guidelines are not necessarily compatible with the short-term marketing strategies of the food and drink manufacturer. This is especially so in the case of sugar with 55% of respondents of the national survey only thinking current concern to be no more than a fad. In other words current consumer concern is not an expression of a permanent move towards a more healthful diet as suggested by general dietary advice, but these respondents may be wrong!

Putting other health aspects aside and looking just at sugar and dental health, Sheiham (Sheiham, 1983) has suggested five measures which should be adopted to achieve an improvement in dental health, these are:

1. No sugars should be added to infant and baby foods, paediatric medicines, fruit juices or vitamin preparations.
2. The levels of added sugars in commonly used foods, such as breakfast cereals and jams, should be reduced and more foods with no added sugars should be made available.
3. The sugar content of confections and drinks should be reduced and sugar-free snacks and drinks made available.
4. Certain products require considerable amounts of sugar substitutes - fructose could be used in sugar products.
5. The information available to the public on sugars and dental health should be approved.

Greater quantities of fructose (isoglucose) will not be available without far-reaching change in the EC Sugar Regime which, in the short-term, seems very unlikely (Graham, 1984). However, in many areas these measures to some extent have been implemented and the survey results confirm that a large number of food and drink manufacturers realise consumers are seriously

concerned about their sugar consumption. Food and drink manufacturers have moved towards producing "sugar-free" and "no added sugar" products and products using sugar substitutes - making a permanent change towards foods with less sugar. There has been a genuine response by food and drink manufacturers in this respect and most believe, as the survey showed, that the majority of consumers are worried sugar is bad for their health. However, there are also sound commercial reasons for these moves and it will be remembered nine out of ten respondents to the national survey agreed other factors are more important to their company's success than consumer attitudes to sugar. It is also hard to guage how much actual sugar substitution has been achieved and how much has been supplementing a market and/or attracting new consumers. Mackay says, talking mainly about the U.S.A. market,:

> "... sugar substitutes so far has created new products which supplement but do not directly compete with sugar-sweetened products, though they may have prevented or impeded growth of sugar products that might otherwise have accrued in the absence of artificial sweeteners." (Mackay, 1987)

There may have been some loss of sugar used in canned products, but apart from this area the use of artificial sweeteners has not directly competed with sugar-sweetened products in the U.K. as well. In this respect, it could be argued, that while dietary guidelines have provoked food and drink manufacturers to produce products that are sugar-free or contain less sugar, giving greater choice to the consumer and helping to put these products on the supermarket shelves rather than in specialist shops, they have also stimulated the British "sweet tooth" by contributing to an overall increase in the total "sweetness" market. "Healthy eating" has undoubtedly given a boost to sugar substitutes. There has not so much been a stride towards a sugar-free nation, but more like a step onto another path.

The increased use of artificial sweeteners has also to be seen as part of a move to more synthetic and artificially fabricated food products. This could eventually see sugar, a "natural" product, being substituted by "unnatural" manufactured bulk replacements. Some nutritionists in the U.S.A. are now warning of a potential imbalance in the average consumer's diet as a result of the mass marketing of synthetic foods (Unger, 1988). The possible increased use of "synthetic" products is apparent when the future of the "sweetness" market is considered, this may see:

- new versions of traditional sweeteners, such as low-density formulations of sucrose, ultra-high fructose syrups, less expensive crystalline fructose and even L-sugars
- new high-intensity sweeteners with improved properties, such as Tate and Lyle's sucralose, Pfizer's alitame, the Sato Stevia Corporation's stevia extract
- new bulking agents physically similar to sugar, but with fewer calories, such as polydextrose, maltitol and lactitol, which may allow high intensity sweeteners to go beyond the soft drinks market
- new classes of intense sweeteners and the use of recombinant DNA technology in design/production

Then there is the ultimate food manufacturers/consumers dream that may not be far away - the fat substitute. NutraSweet announced the fat substitute Simplesse and Proctor and Gamble, Olestra in the past year, although neither is yet approved for use, and Unilever is carrying out tests on its own sucrose polyester fat replacement ("Financial Times", February 24, 1988, p.32). In addition there may be important advances and new knowledge about human physiology in relation to diet and health which will have to be taken into account.

Back in the present, it is still usually only eating patterns leading to "excess" sugar consumption that are considered a dietary problem and this excess is related, not to nutritional requirements, but to what the average British person eats (Quick, 1987). In the main food and drink manufacturers still consider it is the "excess" that is the sugar problem (BNF, 1987). However the impetus of dietary advice on consumers is to have people consider the optimum level of sugar eating not simply "excess" consumption. This change may be occurring and the national survey highlighted that food and drink manufacturers had perhaps also detected a change. However, the fact remains that the industrial purchases of sucrose have actually started to increase in recent years. In some countries, such as Australia, the sugar industry has fought back hard (Thirlwell, 1984) and has stopped the decline in sugar consumption and even seen total consumption start to rise (Sugar Bureau, personal communication, 1987). Currently (1988) the British sugar industry is seriously considering its own generic campaign for sugar to try and produce the same result for the U.K.

It is therefore always important to take a broad-based view when looking at sugar consumption and Gofton warns:

> "The symbolic meaning of sweetness in foods cannot take any priority over the social and economic systems within which these foods are produced and consumed and any analysis of patterns of food consumption must take care to preserve an overview of all the dimensions at both 'micro' and 'macro' levels." (Gofton, 1986)

With this in mind a series of comments by way of general conclusions are presented below, mainly from the results of the 1988 National Survey of Sugar and Sweetener Users, but also information presented in earlier chapters.

Conclusions

* There is a great deal of uncertainty over total sugar consumption in the U.K. Little is known about how much is actually eaten, who eats it, how old they are, and in what products and if there [15]an "at risk" population consuming an "excess".

* The total U.K. sugar and sweetener market may be expanding.

* Virtually all food and drink manufacturers that use sugar as an ingredient are extremely positive about sucrose as a food in the average diet.

* Dietary advice and dietary guidelines have in general, but to a lesser extent about sugar, had a considerable impact on food and drink manufacturers.

* Some companies, especially larger ones, have lost sales due to consumers making changes to their diet in recent years.

* There is a strong underlying attitude among food and drink manufacturers using sugar, that the majority of consumers are unhappy about sugar to the extent of actively cutting down individual intakes.

* Food and drink manufacturers believe current consumer concerns about sugar will have a long-term effect on sugar consumption.

* The emphasis of "healthy eating" has shifted to claims about food additives in products.

* Retailers have played a large role in shaping food and drink manufacturers response to dietary advice.

* In the main, only companies where it is "technically" possible to reduce sucrose in products have exploited apparent consumer fears about sugar eating.

* Although important, consumer attitudes to sugar are secondary to other factors for the success of companies using sugar as an important ingredient.

* Companies using sugar believe consumers are misinformed on sugar and confused about what is a balanced diet since there is no reason for consumers to be concerned about sugar in their diet.

* A large number of companies, especially smaller companies, believe current concern about sugar eating is a fad.

* In many instances consumer attitudes to sugar and related dietary advice makes little or no difference, for example, in some catering situations and other food purchasing points outside of supermarkets.

* Long-term dietary goals and short-term marketing strategies are not necessarily compatible.

* A majority of companies producing sugar-containing products are also actively using or exploring the use of alternative sweeteners to sucrose, but not necessarily because of consumer attitudes to sucrose.

In general, sugar "consumption" has been virtually unaffected by pressures on consumption and consumer attitudes to sugar. Dietary advice, as translated into behaviour by the consumer, has seen a marked and important impact on many food and drink manufacturers producing sweet-tasting foods. However, the total industrial purchases of sugar, so far, have not declined. If consumers are currently turning away from some sugar-containing foods in many instances it may be temporary and they are also eating more of other types of sugar-containing products.

The markets for sugar-reduced or sugar-free products have received a massive boost by "healthy eating" trends, particularly in the area of products sweetened with high-intensity sweeteners. In many cases sugar-free and sugar-reduced products have attracted new consumers to these product ranges. The fact that many such products have been promoted using "sugar-free" claims has, in many respects, been a boost and an additional tool in their marketing, rather than a necessity caused by consumer attitudes to sugar alone. Over time the total "sweetness" market has remained static, although the sugar and sweetener mix making up the total has changed (Tate and Lyle, personal communication, 1988).

However, a majority of consumers are seriously worried about eating sugar as the attitudes expressed by food and drink manufacturers responding to the national survey clearly demonstrates. There is, therefore, a significant risk that there could be wide-reaching changes in sugar consumption patterns by the consumer. It could be predicted that the compulsory labelling of added sugar on food products would see a marked dip in sales of such products, but whether this would be maintained is more questionable.

The marketing activities, taken by food and drink manufacturers, in the continued promotion of sugar-containing products has kept sales high, for example, with soft drinks and confectionery. Also action by the sugar industry

in other countries has halted the decline in sugar consumption, the U.K. industry could try a similar campaign as well as extending its already existing programme in promoting sugar and achieve the same success.

"Unofficial" dietary guidelines coupled with the marketing strategies of different food companies, for one reason or another, have produced confusion and misinformation. There has been a great deal of defensive and offensive activity by the food industry as well as health promoters and the academic community. While there is undoubtedly greater choice in the area of sugar-free and reduced-sugar products, to date there has not been any serious denting of total industrial sugar consumption that can as yet be properly and independently quantified.

6.4 Future Research

A great deal more research in general is required on the food industry. There needs to be, for example, a fuller understanding of the interactions between the various aspects that constitute "agribusiness" and in interpreting the behaviour and role of transnational corporations and their operating policies between countries. More specifically, this research suggests more information is needed in the following areas:

1. On eating habits, behaviour and consumption patterns in respect of food products as well as different sections of the population.
2. The use and sources of information on sugar and sweeteners in influencing and/or changing consumption patterns.
3. How food and drink manufacturers work with retailers in shaping consumption trends.
4. How people can be helped towards a "healthy" diet and the resources needed for this, for example, better health education, the availability of foods, price controls and so on.

5. Understanding consumer attitudes and behaviour towards sweet-tasting products.
6. Dietary advice and the behaviour and response of food and drink manufacturers relative to other factors, for example, can market forces alone successfully implement dietary guidelines?
7. Developing national food and health policies and how these might influence the consumers and food producers.
8. More detailed studies into how different types of consumers respond to dietary advice.

Finally, there is the long-term research programme to understand sugar, diet and health in more detail and how the results of this can be correctly communicated to individuals, together with other dietary advice, to prevent disease and improve the quality of life of many people.

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APPENDIX A

THE 1988 NATIONAL SURVEY OF SUGAR AND SWEETENER USERS QUESTIONNAIRE

THE 1988 NATIONAL SURVEY OF SUGAR AND SWEETENER USERS

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INSTRUCTIONS FOR COMPLETING THE QUESTIONNAIRE 1 - 4

5

In the following two sections are statements about the European Community (EC) Sugar Regime and consumer attitudes to sugar, diet and health. Please indicate by circling one of the alternative answers the extent to which you personally agree or disagree with the statements. There are not meant to be right or wrong answers, it is your opinion that is important. Please circle only **ONE** answer for each statement. 6 - 9

10

SECTION ONE : STATEMENTS ABOUT THE EUROPEAN SUGAR REGIME

1. The EC Sugar Regime gives my company security of supply

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree 11
e. I strongly disagree
f. I completely disagree

2. The EC Sugar Regime gives stability to sugar prices

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree 12
e. I strongly disagree
f. I completely disagree

3. The present EC Sugar Regime unfairly discriminates against the food manufacturer

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

4. Reform of the EC Sugar Regime should not be a top priority within the Common Agricultural Policy 13

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

14

5. The European price of sugar is kept too high

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

15

6. Obtaining supplies of sugar in a 'free' world market would be much better as far as my company is concerned

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

16

7. The EC Sugar Regime, in principle, is a sensible way to organise a market for an agricultural product

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

8. **The EC Sugar Regime is fair to sugar cane producers** 17

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

9. **The EC Sugar Regime stops my company from fully exploiting available alternative sugars to sucrose** 18

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

10. **Artificial sweeeteners should be incorporated into the EC Sugar Regime** 19

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

20

11. **The price my company has to pay for sugar means my company's products are more expensive in the shops than they otherwise would be**

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

12. The EC Sugar Regime discriminates against farmers 21

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

13. My company is not really interested in what happens within the EC Sugar Regime 22

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

14. The present EC Sugar Regime means higher prices for consumers 23

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

15. Food manufacturers are under-represented in the decision-making process of the EC Sugar Regime 24

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

16. The EC price of sucrose makes the use of artificial sweeteners more attractive 25

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

17. The EC Sugar Regime does not take into account the needs of food manufacturers 26

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

18. In the UK, glucose syrups will be more widely used in food manufacturing in the future 27

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

19. The EC Sugar Regime only very indirectly affects my company 28

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

20. The EC Sugar Regime should allow food manufacturers greater access to supplies of isoglucose 29

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

21 The EC Sugar Regime gives too much power to British Sugar Plc 30

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

22. The EC Sugar Regime gives too much power to Tate and Lyle Plc 31

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

SECTION TWO : STATEMENTS ABOUT SUGAR, DIET AND HEALTH

32

1. Sugar is a natural part of a balanced diet

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

33

2. Sugar is used by my company for a combination of its technical properties

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

34

3. A small number of consumers are worried sugar might be bad for their health

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

35

4. Consumer attitudes towards sucrose have encouraged my company to develop products using alternative sweeteners

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

5. Taste is the most important reason why my company uses sugar as an ingredient 36

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

6. Cutting back on sugar consumption by consumers is just another eating fad 37

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

38

7. Consumers making changes to their diet in recent years has resulted in lower sales of some of my company's products

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

39

8. Consumers are confused about what is and what is not a healthy and balanced diet

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

9. Consumers are not very interested in their individual sugar consumption 40

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

10. Consumer views on "healthy eating" have played only a small part, if any, in my company's marketing strategies to date 41

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

11. It is "technically" possible to reduce some of the sucrose in my company's products 42

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

12. The recommendation by some health experts that average UK sugar consumption should be cut by half <u>is</u> a realistic target 43

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

13. It is up to the individual to think about whether they are getting a balanced diet 44

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

14. A small reduction in average sucrose consumption would be better for the nation's health 45

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

15. The "healthy eating" lifestyle is here to stay 46

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

16. The majority of consumers are worried sugar might be bad for their health 47

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

17. My company is fully aware of the dietary recommendations that talk about average sucrose consumption 48

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

18. Consumer attitudes to sugar have resulted in lower sales of some of my company's products 49

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

19. Factors other than consumer attitudes to sugar are more important to the success of my company 50

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

20. The majority of consumers are actively trying to cut down on their individual sugar intakes 51

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

21. Current consumer concerns about diet and health will make no difference whatsoever to average sugar consumption in the long run

52

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

53

22. Sugar-reduced or sugar-free products will always be a small segment of the total market in which my company sells

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

54

23. In the long-run the sugar, diet and health debate is of little or no relevance to my company's success

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I mildly disagree
e. I strongly disagree
f. I completely disagree

24. My company now considers it worthwhile to explore manufacturing products using sweeteners other than sucrose

55

a. I completely agree
b. I strongly agree
c. I mildly agree
d. I midly disagree
e. I strongly disagree
f. I completely disagree

SECTION THREE : ABOUT YOUR COMPANY

1 - 4

IMPORTANT NOTE : The information in this section is required for statistical analysis. As in Sections One and Two, full confidentiality is assured and results will be aggregated so no individual company can be identified. 5 6 - 9

1. How many people does your company employ? 10

(Please tick appropriate box)

11 -

less than 100 ☐ 101-500 employees ☐ more than 501 ☐

2. What are your company's product categories that use sugar and sweeteners as an ingredient, for example, biscuits, breakfast cereals, sugar confectionery, and so on .

(Ranked in order of importance up to a maximum of five)? 12 - 13

1 _____ 14

2 _____ 15 - 16

3 _____ 17

4 _____ 18 - 19

5 _____ 20

21 - 22

23

24 - 25

26

3. What is your company's annual turnover? 27

(Please tick appropriate box)

less than £2.5 million ☐

£2.5 million to £20 million ☐

more than £20 million ☐

4. Does your company manufacture products sold under a retailer's own label? (Please tick appropriate box) 28

Yes ☐ No ☐

5. Since October 1983 have any of your company's products, including any own label products, been specifically promoted and marketed at the 'healthy eating' segment? 29
(Please tick appropriate box)

Yes ☐ No ☐

6. Since October 1983 have any of your company's products used one of the following marketing strategies in their promotion? 30
(Please tick as many that apply)

no sugar	☐	no artificial flavourings	☐ 31
			32
sugar free	☐	no artificial colourings	☐ 33
			34
sugar reduced	☐	high fibre	☐ 35
			36
no added sugar	☐	contains artificial sweetener	☐ 37
			38
no additives	☐	none of these	☐ 39
			40
low calorie	☐	others	
		(please specify no more than three)	41
		.....	42
no preservatives	☐	.....	43 -
		.....	44-45
			46-47
			48-49
			50 -

7. Please give your company's volume of purchases (in metric tonnes) for the following sugars (if none, please state none) Please answer as exactly as feasible. 1- 4 5 6- 9

Total sucrose

(metric tonnes)	Year	Purchased	
	1984	_____	10-14
	1985	_____	15-19
	1986	_____	20-24

Total Isoglucose

(metric tonnes)	Year	Purchased	
	1984	_____	25-29
	1985	_____	30-34
	1986	_____	35-39

Total Glucose Syrups

(metric tonnes)	Year	Purchased	
	1984	_____	40-44
	1985	_____	45-49
	1986	_____	50-54

Total Other Sugars
(for example, fructose, syrups and treacles)

(metric tonnes)	Year	Purchased	
	1984	_____	55-59
	1985	_____	60-64
	1986	_____	65-69

1- 4

8. Please give your company's volume of purchases (in kilogrammes) 5
for the following sweeteners (if none, please state none) 6- 9
Please answer as exactly as feasible .

Bulk Sweeteners
(in kilogrammes)

	Year	Purchased	
that is; hydrogenated			
glucose syrups, sorbitol,	1984	_____	10-14
xylitol, mannitol, isomalt	1985	_____	15-19
	1986	_____	20-24

High Intensity Sweeteners
(in kilogrammes)

Aspartame	Year	Purchased	
	1984	_____	25-28
	1985	_____	29-32
	1986	_____	33-36

Saccharin	Year	Purchased	
	1984	_____	37-40
	1985	_____	41-44
	1986	_____	45-48

Acesulfame	Year	Purchased	
	1984	_____	49-52
	1985	_____	53-56
	1986	_____	57-60

Thaumatin	Year	Purchased	
	1984	_____	61-64
	1985	_____	65-68
	1986	_____	69-72

9. What is the status of your company? 74
(tick one box only)

a. A fully independent/autonomous company ☐

b. Operates as an independent/autonomous company, although part of a larger group ☐

c. Effectively under the control of a larger group ☐

10. Finally, your comments are welcomed on any of the points raised by this questionnaire, especially in relation to consumer attitudes to sugar, diet and health (Continue overleaf if necessary)

THANK YOU FOR YOUR HELP AND CO-OPERATION

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